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COVER PICTURE

Aberdeen Angus and Hereford cattle on the property of E. Clark and Son, "Wendowie," Serpentine. At one time one of the best dairy farms of the district was established here.

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The New Deputy Director



Mr. F. L. SHIER, B.Sc. (Agric.)

Mr. Shier brings a wealth of experience to his new appointment. From Bunbury High School he entered the University of Western Australia as a cadet of this Department in 1922, and graduated as a Bachelor of Agriculture Science in 1926. He was stationed in the Geraldton district where he had much to do with the experiments and working at the Chapman Research Station, Nabawa.

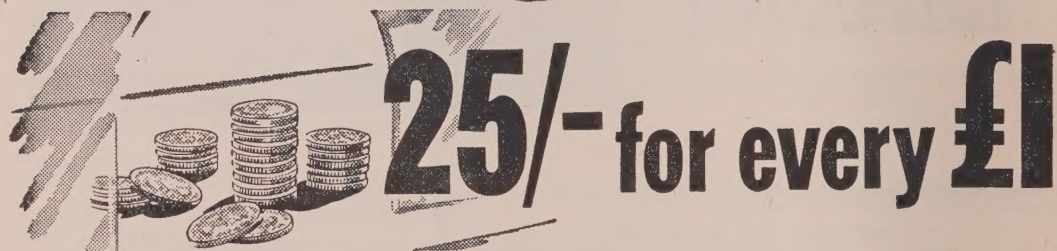
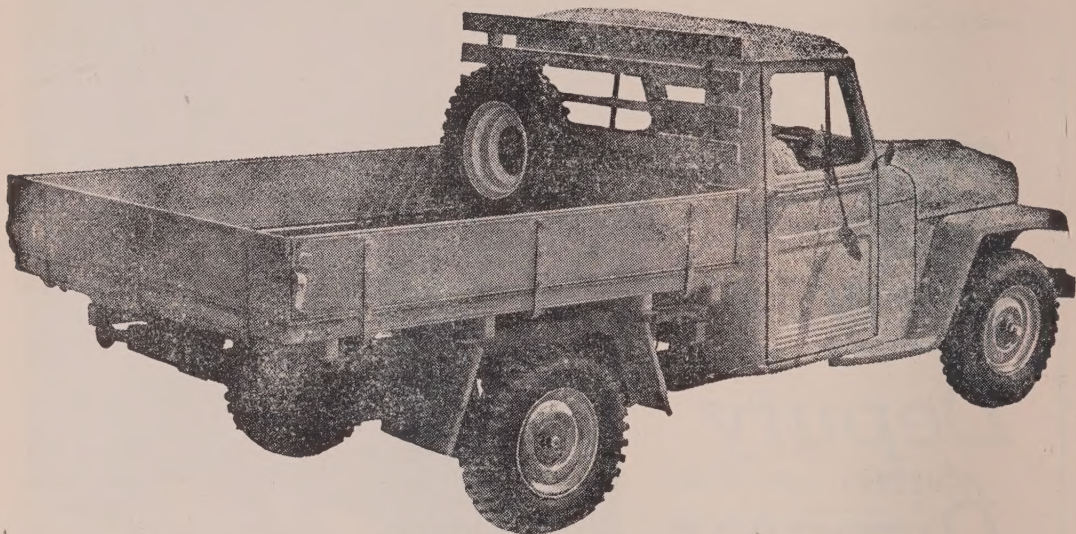
In 1934 he was transferred to Perth and was associated with all the major developments of the Wheat and Sheep Division of the Department which have occurred since. He was the original State member of the Commonwealth Technical Sub-Committee of Fat Lamb Production.

In 1953 the same year in which he was appointed Superintendent of the Wheat and Sheep Division, he visited New Zealand and investigated agricultural extension methods and their possible application under Western Australian conditions.

He received leave of absence in 1955-56 to spend time in Syria and nearby Arab countries to investigate and advise improvements for the Food and Agricultural Organisation of the United Nations.

He has been closely associated with the present Director of Agriculture (Dr. T. C. Dunne), in the development of the clover ley system of farming in this State, and in the establishment of the Research Station at Esperance and the experimental programme which has had success in the development of light lands in the south coastal region.

He is chairman of a number of agricultural committees including the Central South Zone Development Committee, the State Meat Advisory Committee and the Advisory Committee on Animal Health and Production. He is also a member of the Wheat Research Council and the State Wheat Research Committee, and is a past president of the W.A. Branch of the Australian Institute of Agricultural Science.



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WEST AUSTRALIAN RANDOM SAMPLE

EGG LAYING TEST, 1959-1960

By R. H. MORRIS, B.Sc. (Agric.), Officer in Charge, Poultry Branch

AS part of the poultry improvement plan for Western Australia, the Department of Agriculture inaugurated a random sample laying test for commercial grade chickens at the Poultry Research Station, Herdsman Lake, in 1957. The results of the first test appeared in the May-June, 1959 issue of the *Journal of Agriculture* and those of the second test in the June, 1960 issue.

Day old chickens for the third test were taken at the end of July, 1959, and the test terminated in December 1960.

An account of the third test is given below and some comparisons are drawn between the first three tests.

In keeping with the two previous tests, names of those hatcherymen who patronised the third test are not disclosed. A number only will be used to identify each entry until the results of the sixth test are known.

When the sixth test has finished entrants will be ranked by name in accordance with the average profit per bird achieved by their stock in the fourth, fifth and sixth tests. From then on, test results including names will be released yearly, based on the three most recent years.

These three year average lists will provide chick buyers with a very accurate guide as to the quality of chickens sold by the respective hatcheries and will provide a further incentive to hatcherymen to improve the quality of their chickens which they sell as commercial laying stock.

Many hatcherymen have already established their poultry breeding programmes and are receiving technical assistance from officers of the Department of Agriculture.

COMPOSITION OF ENTRIES

There were 27 entries in each of the first three tests.

There was no control flock in the first two tests but a control flock supplied by the C.S.I.R.O. Poultry Research Centre, Werribee, Victoria, was included in the third test and chickens from this flock which will remain genetically constant over the years will be used as a control flock in subsequent tests. This control flock, in acting as a check on the effect of environmental differences from one test to another, will enable poultry breeders to determine the rate of progress they are making in breeding better stock, and will also serve as a check on environmental differences between the various Australian Random Sample Tests which use this strain as a control flock.

The composition of the entries in the first three tests was as follows:—

1st Test—all Crossbreds.

2nd Test—23 Crossbred (22, W.L. x Aust. and one, Aust. x W.L.), two White Leghorn and two Australorp entries.

3rd Test—22 Crossbred (W.L. x Aust.), four White Leghorn, one Australorp plus one White Leghorn control flock.

In every table given at the end of this article the results achieved by the control flock are listed separately from those achieved by the ranked entries.

ELIGIBILITY TO ENTER TEST

For a hatcheryman to be able to enter any particular breed, he had to sell 2,000 female chickens of the breed or crossbreed applied for in that year.

It is estimated that the hatcherymen who patronise the Western Australian test sell at least 95 per cent. of the chicks sold in the State.

SAMPLING THE TEST CHICKENS AT THE HATCHERY

Day old chickens for the third test were taken at random from the chicks offered for sale by the participants on or about July, 29th 1959, over an eight-day period.

Officers of the Department of Agriculture took the samples in such a way that each sample was truly representative of the stock offered for sale by the hatcheryman concerned, and subsequently entered in the test.

A sample consisted of 60 sexed female chickens and when the survivors were eight weeks old they were randomised down to 48 chickens per entry. The test officially started at this time and extended over a thirteen weeks and 3 days growing period—9 to 21 weeks and 3 days inclusive, and a 50 week laying period—21 weeks and 3 days to 71 weeks and 3 days or 500 days inclusive. No culling was practiced throughout the duration of the test.

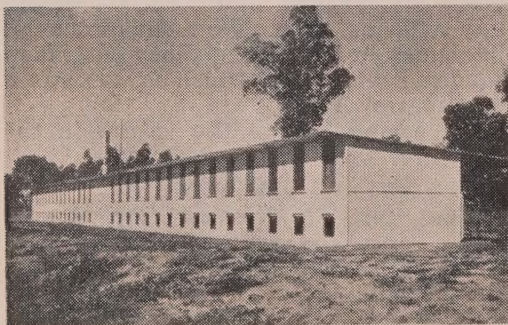


Fig. 1.—The new brooder house measuring 162 ft. by 10 ft. with a 5 ft. verandah along the back wall contains 30 brooding compartments each 5 ft. by 10 ft. and a central compartment which houses the boiler for the hot water brooding system

Entries were evaluated and ranked according to the profit returned by each bird commencing the test at eight weeks (see Table E). The profit per bird figure takes into account all the factors such as egg numbers, egg size, body weight, mortality and feed efficiency which when combined determine the economic value of a strain.

BROODING, REARING AND HOUSING

The day old chickens were brooded with the use of a hot water system. At eight weeks the test officially started, the chickens were wingbanded in both wings and all pullets in excess of 48 per entry were ballotted out. Cockerels were also removed at this time.

The chickens in the second test were brooded and reared in sheds 27 yards away from adult birds but because of the high incidence of avian leucosis in the second random sample laying test a new brooder house was built to receive the day old chickens in the third test.

This brooder house (see Fig. 1) was built 162 yards from the nearest birds on the station and against the prevailing wind. In addition, each entry was brooded within itself and entries were not allowed to intermingle for the first 8 weeks. No one entered the pens during this time. The chickens were kept intensively on litter and for the first 8 weeks were allowed floor space at the rate of 0.83 square feet per chicken.

At 8 weeks, two thirds, i.e., 32 pullets from each entry were removed to two rearing sheds within 27 yards of adult stock. Each shed contained 16 pullet chicks from each entry and the chickens in each group were allowed to intermingle within themselves. The remaining 16 pullet chicks from each entry were left in the brooder house. During the day these chickens were allowed out on range en masse. This meant that from 8 weeks the chickens from each entry were spread evenly over three sheds. Two of these sheds were within 27 yards of adult birds while the other was 162 yards away from the adult birds.

Records were then kept to see if:—

- (a) The mortality from leucosis in birds in the third test was lower than in those entered in the second test. (Note:—The chickens

Table 1

	Test 2	Test 3
Per cent. mortality due to all forms of leucosis based on the number of chicks which commenced the test at 8 weeks	37.3	29.9

in the second test were allowed to intermingle from day old and were brooded and reared in a shed only 27 yards distant from adult birds.)

- (b) The 16 chicks from each entry which were housed in isolation for the full rearing period during the third test survived better than their 32 sisters that were housed from 8 weeks within fairly close proximity to adult stock in which the incidence of leucosis was high. (Actually from 14 weeks of age the 32 pullets from each entry were allowed to range to within 9 yards of the adult birds but from 8 to 14 weeks they were kept to within 27 yards of the adults.)

Referring to (a) above it will be seen from Table 1 that the incidence of leucosis in the third test was less than in the second test—29.9 per cent. as against 37.3 per cent. of birds alive at 8 weeks died from leucosis during the test but it would be impossible at this stage to say whether or not the new brooder house helped in this regard. The results from several years testing may provide leads in controlling this disease. In the meantime farmers would be well advised to brood and rear their chickens as far removed as practicable from any older birds

on the farm, with the object of trying to reduce infection.

Referring to (b) it will be seen from Table 2 that the mortality rates in those chickens kept isolated in the new brooder house for the full rearing period in test 3 and those allowed in close proximity to adult birds from 8 weeks, were practically identical.

Chicks in the fourth test have been housed in a somewhat similar manner to those in the third test, but 12 instead of 16 chickens from each entry have been held over in the isolated brooder house from 8 weeks and these 12 chickens unlike the 16 in the previous test have been intensively housed within themselves for the full rearing period. These 12 chickens which constitute one quarter of each entry will also be housed within themselves as laying birds for the full period of the test and it will be interesting to observe whether these birds which have had no contact with other birds survive better than the remaining 36 birds in each entry.

THE LAYING SHEDS

At 21 weeks and three days, all pullets in the third test were transferred to their laying quarters. These consist of two lines of naturally lit, intensive, deep litter sheds (see Fig. 2). In all, 120 pens, each 8 ft x 6 ft. are provided and at 21 weeks and three days the survivors from the original 48 pullets per entry were allocated at random to four of these small pens. The birds then underwent a 50 weeks laying test.

Table 2

	Fowl paralysis	Visceral leucosis	Other forms of leucosis including birds which had any two forms of leucosis	Total
* Per cent. mortality for the full test period in those chickens kept isolated during the rearing period	13.7	11.8	1.6	27.1
* Per cent. mortality for the full test period in those chickens placed within 27 yards of adult birds from 8 weeks to 21 weeks and 3 days	18.5	11.1	1.5	30.1

* Note:—All percentages are based on the number of chickens alive at 8 weeks.

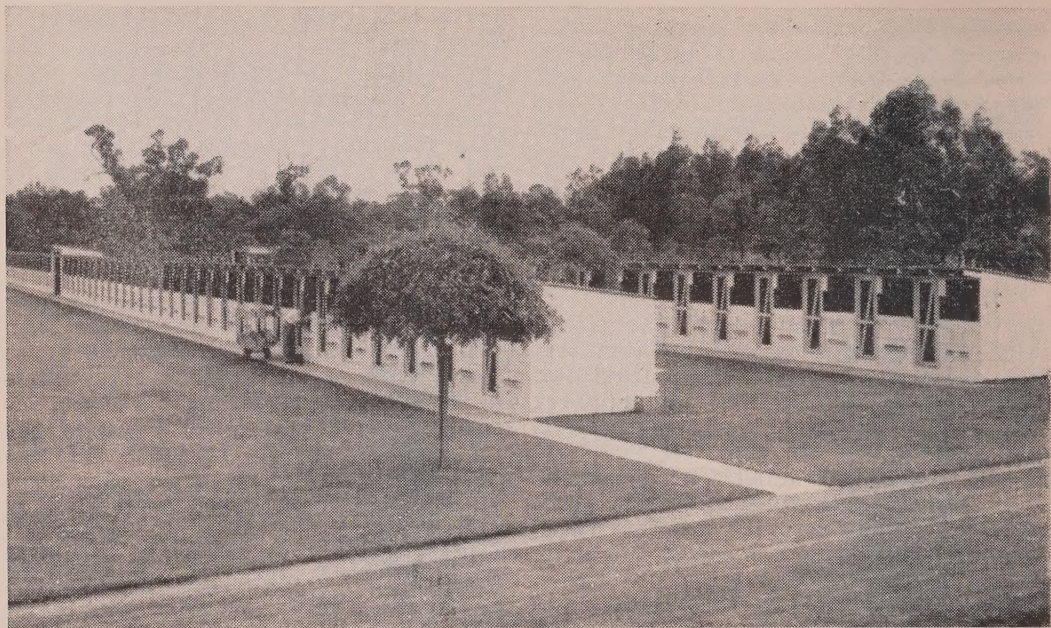


Fig. 2.—The two rows of intensive laying pens surrounded by lawns. In all there are 120, 6 ft. x 8 ft. pens and the 48 birds from each entry occupy four of these.

The dry mash, green feed and insoluble grit are fed through the feed shute into a feed trough in each pen. The eggs are collected from outside and in front of the pens through a sliding door just above the feed shute.

A continuous water trough runs along the back of the pens and a water cistern can be seen below the raised ventilation flap in the centre of the picture.

EVALUATION OF ENTRIES

As mentioned above, entries are evaluated and ranked according to the profit returned by each bird commencing the test at eight weeks (see Table E). The value of the food eaten by each entry for the 63 weeks and 3 days from the eight-weeks old stage is subtracted from the income figure (value of eggs laid plus carcass values of survivors at 71 weeks and 3 days) and the gross profit figure for the entry is then divided by the number of pullets officially commencing the test at eight weeks.

The Western Australian tests commence when the pullets are 8 weeks old because in commercial practise early chick mortality is usually not of great economic importance and as the assessment of entries is on economic grounds it is considered advisable to disregard losses which occur prior to eight weeks. Of the 27 entries in the third test, 22 entries commenced the test with 48 pullets each, and 5 entries with 47 pullets each.

ASSESSMENT OF CARCASS, EGG AND FOOD VALUES

- (a) *Carcass Values*.—Carcass values are based on a standard price (of 2s. 3d.) per lb. irrespective of the birds body weight.
- (b) *Egg Values*.—Egg values are calculated on values established by the candling and grading of one day's production per week throughout the laying period.
Egg values conform with standard Egg Board gradings and values in force at that time—on a net return to producer basis.
- (c) *Food Values*.—All food fed during the 50 week laying test period was weighed and valued at 3.9d. per pound. The food eaten during the rearing period (9 to 21 weeks and 3 days) was valued at 3.5d. per pound.

As it was not possible to measure the feed eaten by the birds in each entry during the rearing period because they were running en-masse we had to rely on a

figure derived from a formula kindly supplied by Mr. S. T. King, of the United States, Department of Agriculture.

When the body weight of the bird at the time of housing is known the formula which includes this figure can be used to calculate the food eaten from day-old, but as our test does not start until the chickens are eight weeks old, the food eaten per bird during the first 8 weeks had of course to be deducted from the calculated figure.

When a bird dies during the rearing period, the value of the food which it has eaten from the eight-weeks-old stage to time of death is debited against the entry concerned.

CAUSES OF MORTALITY

The incidence of disease in the first test was very light, only 5.78 per cent. of the chickens alive at eight weeks dying during the test, that is to 68 weeks.

In the second test the mortality rate was excessive, no less than 547 or 43.4 per cent. of the 1,282, 8-weeks-old chickens which started the test dying before they had reached 68 weeks of age and the test ended. Avian leucosis accounted for 478 or 87.4 per cent. of the total deaths.

Avian leucosis was also the biggest killer in the third test. Total mortality from 8 weeks in the third test amounted to 464 birds or 35.9 per cent., and 385 birds or 83.0 per cent. of those which died succumbed to one form or another of the leucosis complex.

In the second test the neural or fowl paralysis form of leucosis accounted for no less than 366 or 66.9 per cent. of the total deaths, and in the third test the figure was 219 or 47.2 per cent. of the total deaths. The disease next in importance in both tests was visceral leucosis which in the second test accounted for 81 or 14.8 per cent. of the total deaths. In the third test visceral leucosis was much more important and accounted for 146 or 31.5 per cent. of the total deaths.

There was a marked similarity in the pattern of deaths from leucosis in both the second and third tests with the incidence of fowl paralysis reaching a peak at about the time the birds were coming into production and with losses from this cause persisting but becoming gradually less as the tests progressed (see Table F).

On the other hand visceral leucosis was not of great importance during the early

part of the laying year in either test but during the last 20 weeks of test two it accounted for as many deaths as fowl paralysis and in test three for twice as many deaths as fowl paralysis.

Table F shows the incidence of disease in the third test from day old to 71 weeks and 3 days in periods of approximately 10 weeks each.

EARLY CHICK MORTALITY

In the second test 142 chicks died in the 0-8 weeks period representing 9.48 per cent. of the 1,498 chickens taken into the test at day old.

In the third test this figure was reduced to 34 chickens or 2.10 per cent. of the 1,620 chickens taken into the test at day old. Even up to the 16th week only 43 chickens or 2.65 per cent. of the chickens alive at day old had died.

In this third test no chickens were lost from coccidiosis in any of its forms, whereas 64 chickens died from coccidiosis during the first 8 weeks in the second test.

Nineteen chickens died from omphalitis in the second test but only nine in the third test.

It will thus be seen that despite the good rearing results to 16 weeks in the third test losses from fowl paralysis began to mount after this time and later visceral leucosis took its toll (refer Table F).

VALUABLE INFORMATION OBTAINED

Despite the effect which avian leucosis had on the third test, valuable data was obtained on egg production, food consumption, egg size, broodiness, rate of maturity, bird weight, egg quality, etc., and apart from odd entries the repeatability of the entries that competed in both the second and third tests was quite good.

For example most of the entrants who did well in the second test also did well in the third test. Of the entrants whose stock filled the first 15 positions in the second test, and who also entered the third test with the same type of stock (Crossbreds—W.L. x Aust.) ten again finished within the first 15 places in the third test. This was a very good result in view of the fact that stock from two new entrants filled two of the remaining five positions in the top 15 positions in the third test.

Five of the competitors who have entered crossbred (W.L. x Aust.) stock in all three

tests have gained an above average result in each test and in the third test stock from four of these entrants filled first, second, third and fifth places respectively. There is thus every reason to believe that the three year average lists will, when published, provide some very worthwhile and accurate information.

Rate of lay is always an important factor in determining profitability and despite the high mortality that occurred in both the second and third tests rate of lay still had a large influence on the final placings. This can be seen from (Table 3). The mortality rate was low in test one, but high in tests two and three. Because of this the hen day figure as a measure of egg production, has been used as, unlike the hen-housed figure, it makes allowance for mortality.

Many other factors apart from egg production influenced the final profit, and mortality certainly played a part in both the second and third tests. However, it should be realised that even in a test where

Table 3

	Test		
	First (1957-58)	Second (1958-59)	Third (1959-60)
Hen day egg production top 14 entries	194.5 eggs	180.7 eggs	180.2 eggs
Hen day egg production bottom 13 entries	185.9 eggs	165.3 eggs	154.1 eggs

the overall mortality is quite low, individual entries are likely to be seriously interfered with through mortality and this is one of the many reasons why too much reliance should not be placed on the results of any one particular test. Chick buyers should be more concerned with the average results achieved by their hatcherymen's stock in three or more consecutive tests, than by the results achieved in individual years. Good consistent performance is much more important than superior performance in a single test.

This is why the Department of Agriculture when it releases the names of those



Fig. 3.—Twenty-two of the 27 entries in both the second and third tests were the White Leghorn-Australorp cross shown here. This is the most popular egg-producing bird in Western Australia.

hatcherymen who patronise these tests, will rank the entrants on the basis of the performance of their stock in three consecutive tests.

EGG GRADINGS AND EGG SIZE

Egg size and egg quality have an important bearing on the final position which any entry fills and it will be seen from Table C that first quality hen eggs are graded into three grades in Western Australia. These are known as the 12 lb., 14 lb., and 16 lb. packs respectively. The grades are based on the weight of a "long-hundred" or ten dozen eggs, the smallest pack containing ten dozen eggs and weighing 12 lb.

In addition to the three local grades, there are two export grades for eggs of the very highest quality and which in other respects would qualify for the 14 lb. and 16 lb. packs respectively. As an incentive for quality, an export grading carries with it a premium payment of twopence per dozen over and above the price paid for the corresponding local pack.

The 12 lb. local pack includes eggs which weigh not less than 1½ oz. but less than

1¾ oz. each; the 14 lb. pack, eggs of not less than 1¾ oz. but less than 2 oz. each and the 16 lb. pack, eggs which weigh not less than 2 oz. each. For the export 16 lb. pack only eggs which weigh between 2 oz. and 2¾ oz. inclusive are accepted.

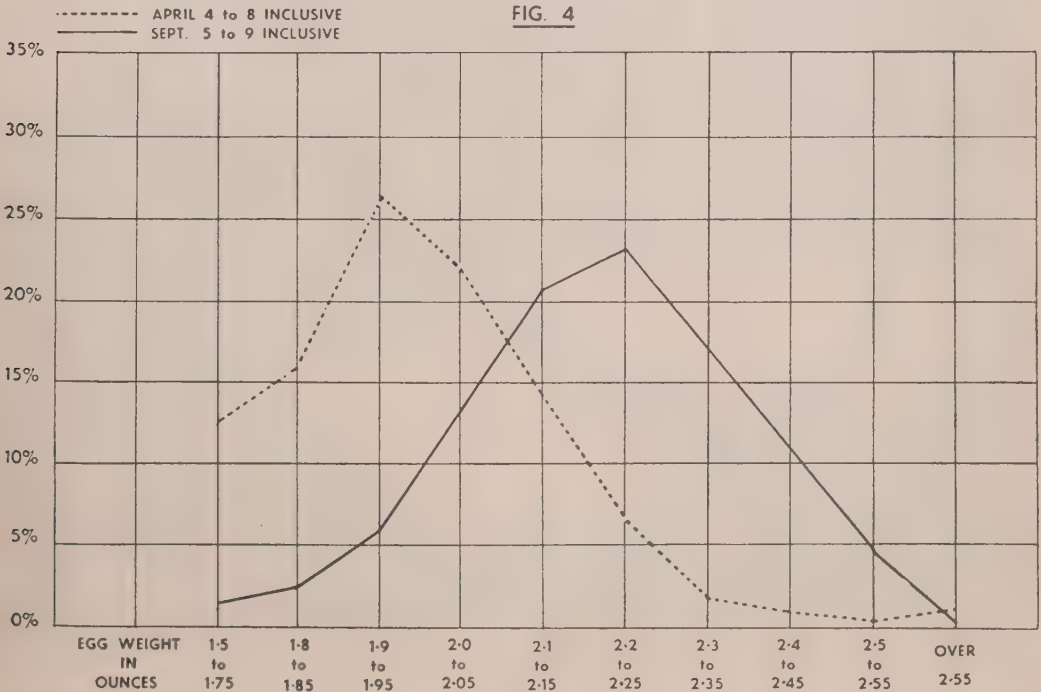
Average egg weight figures for each entry were determined at fortnightly intervals throughout the laying period by bulk weighing all eggs laid on a particular day.

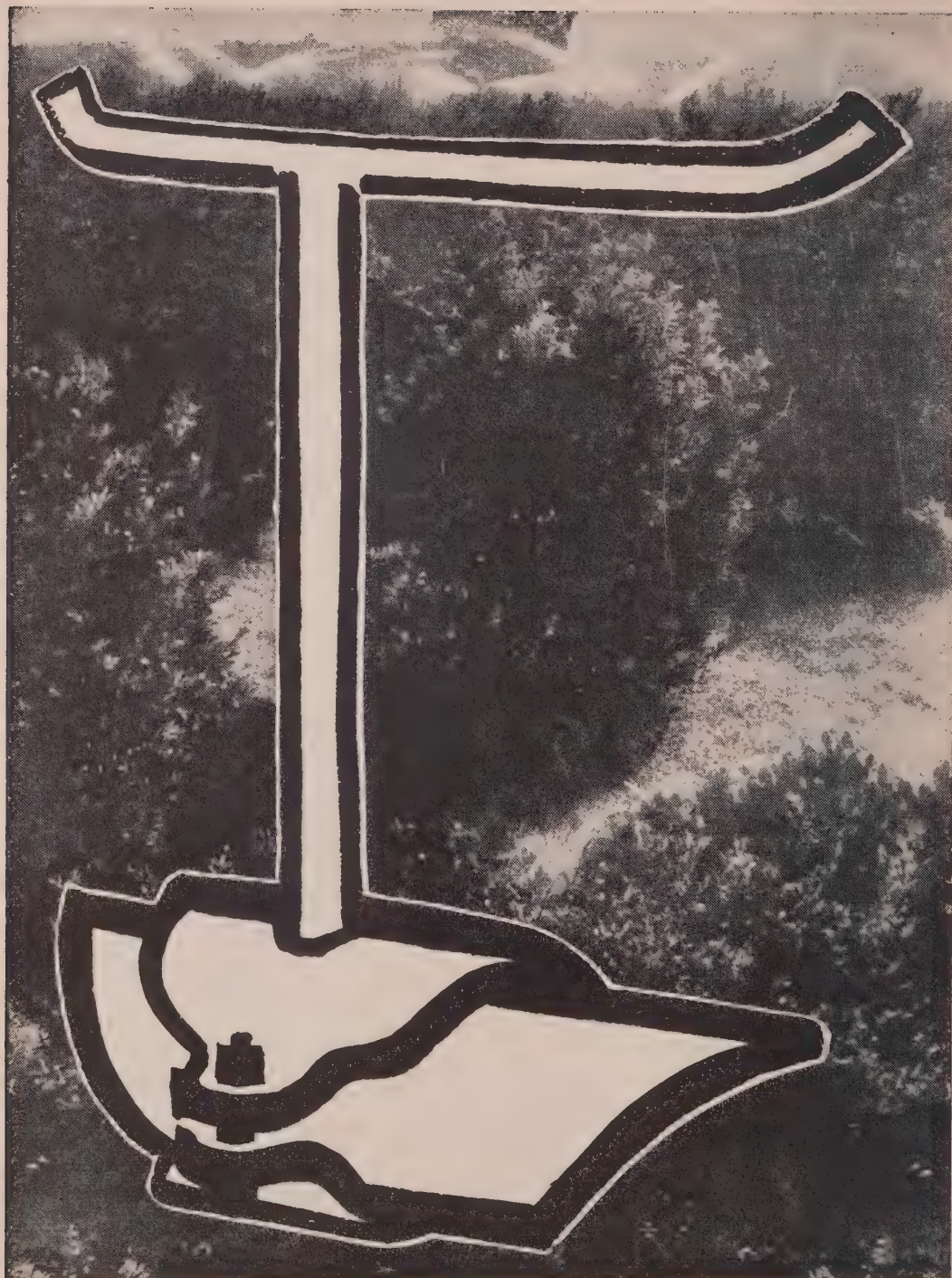
The true average figure for the year shown in Table C, column 2, was then calculated from the fortnightly figures.

The graph (Fig. 4) showing the distribution of eggs by weight at two periods in the test shows how egg size increased as the year progressed.

The broken line relates to 3,182 eggs laid by all entries from April 4 to April 8 1960 inclusive, i.e., during a five day period at 36 weeks of age. At this time 26.1 per cent. of all eggs laid weighed between 1.90 and 1.95 ounces inclusive, and 6.4 per cent. of the eggs weighed between 2.20 and 2.25 ounces inclusive.

Later in the year when the birds were 59 weeks of age, 2,881 eggs laid by all





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entries from September 5 to September 9 inclusive were weighed and it was found that only 5.5 per cent. of them weighed between 1.90 and 1.95 oz. while 23.1 per cent. of them weighed between 2.20 and 2.25 oz. inclusive.

Each entrant was provided with the egg size pattern of his own entry at the two periods in the year mentioned above, together with the average pattern of all entries. Additional data relating to egg size and contained in (Table C), enables each entrant to compare the egg size of his entry with all other entries.

Generally speaking, small egg size cannot be regarded as a major problem in Western Australia at the present time, but average egg size for the third test dropped to 2.06 ozs. compared with 2.11 ozs. for the second test and as egg size can easily be sacrificed at the expense of egg numbers, breeders should strive to preserve an economic balance between these two factors in their future flock improvement work.

DEWORMING, VACCINATION AND DEBEAKING

The growing stock were dewormed twice. At 10 weeks, each bird was drenched with 1½ ccs. of carbon tetrachloride and at 17 weeks with 3 ccs. of carbon tetrachloride. Two dewormings were also given during the laying period, using a vermifuge in the drinking water.



Fig. 5.—Accurate record-keeping is an essential requirement of a successful Random Sample Laying Test. All test data is promptly dealt with by Mr. F. A. E. Hunt as it becomes available who is shown here (left), calculating and transcribing results on to an entries history sheet, while Mr. J. A. Hoy makes a final check on an entrant's progressive report prior to it being forwarded to the hatcheryman concerned

Vaccination against fowl pox was carried out at 12 weeks.

Cannibalism was effectively prevented by debeaking the birds at the time they were housed in the laying pens.

FEEDING

The birds were fed under the dry mash and greenfeed system, the rations being changed according to the age of the birds (see table).

SOME GENERAL OBSERVATIONS

Entries are ranked (see Table E) according to the profit made per bird. The winning entry in the first test had a profit of £1 19s. per bird, and the entry which finished 27th, £1 10s. per bird. The average was £1 14s. 9d.

In the second test the winning entry had a profit per bird figure of £1 11s. 1d., and the lowest entry only 8s. 5d., with an average of £1 2s. 3d. The heavy mortality in the second test was largely responsible for the lower profit. For instance the entry with the profit of 8s. 5d. only had 16 birds remaining at the conclusion of the test.

In the third test the average profit figure was a little higher namely £1 2s. 11d. The top entry had a profit figure of £1 10s. 8d. and the lowest entry 14s. 7d.

Several factors contributed towards this higher average profit. Compared with the second test fewer birds died in test three and the average egg price was higher namely 3s. 11d. a dozen against 3s. 10½d. for test two. Also the birds were valued at 2s. 3d. per pound live weight at the conclusion of the test instead of 2s. 1d. and the test ran three weeks and three days longer than the second test, namely from 8 weeks to 71 weeks and 3 days, instead of to 68 weeks.

On the other hand the rate of lay for test three (168 eggs) was not as high as for test two (174 eggs) despite the fact that the 50 week laying test for the third test did not commence until the birds were 21 weeks and 3 days of age, i.e., 3 weeks and 3 days later than for test two.

Compared with the second test the deaths in the third test were more evenly distributed. The entry with the highest mortality this year lost 20 birds as against 32 birds last year and the entry with the lowest mortality, 10 birds as against 6 birds last year.

INGREDIENTS	CHICKEN RATIONS			LAYERS' RATIONS
	0-8 weeks	9-12 weeks	13-18 weeks	From 18 weeks
Bran	lb. 25	lb. 25	lb. 25	lb. 20
Pollard	10	10	10	10
Finely Gristed Oats	10	10	10	10
Gristed Wheat	60	60	60	60
Wheameal (66 per cent. protein)	5	5	4	7
Meatmeal (50 per cent. protein)	6	5	4	8
Dried Buttermilk Powder	3	2	....	....
Dried Brewers' Yeast	2	....	....	....
Bone Flour	3	3½	4	2½
Oyster Flour ....	....	....	....	2½
Common Salt (fine)	½	½	½	....
*Common Salt, Manganese Sulphate mixture ....	....	....	....	10 oz.
Manganese Suphate	1 level teaspoon	1 level teaspoon	1 level teaspoon	....
†Synthetic Riboflavin mixture	½	½	½	....
Vitamin A and D ₃ Feeding Supplement	According to the Manufacturers' Recommendations			....
TOTALS	125 lb. plus 1 teaspoon	121½ lb. plus 1 teaspoon	118 lb. plus 1 teaspoon	120 lb. 10 oz.
Estimated crude protein content	16 per cent.	15 per cent.	14 per cent.	16 per cent.

* The common salt, manganese sulphate mixture is obtained by mixing 4 oz. of manganese sulphate in 10 lb. of finely ground common salt. For the above layers' ration, 10 oz. of this mixture are used in every 120 lb. of mash.

† The synthetic riboflavin mixture is made by thoroughly mixing a 4 gm. packet of "Ribon" into 16 lb. of pollard, making a premix first and then gradually breaking it down with the 16 lb. of pollard.

Greenfeed: The laying birds are fed fresh kikuyu lawn clippings daily at the rate of 1½ oz. per bird. The baby chicks also received finely cut green feed which had not been fertilised with poultry manure.

Insoluble Grit: Irrespective of age, the birds always have free access to insoluble grit.

A coccidiostat was included in the chicken mash for the first ten weeks at the preventative level.

The chickens for the third test were hatched approximately 14 days earlier than those in the first and second tests, namely July 29th instead of August 12th, and the pullets in the third test came into production earlier.

The average age at first egg in the third test was 148 days compared with 156 days in the second test and 162 days for the first test.

However the average age at which a 50 per cent. rate of lay was achieved in the third test was 205 days compared with 194 days for the second test and 195 days for the first test. In the third test a longer time was required for the birds to reach a 50 per cent. lay mainly because of the slowness with which all 5 pure-bred entries and odd cross-bred entries came into production.

None of the 5 pure-bred entries in this test performed particularly well and despite the small egg size and low price per dozen figures achieved by the Victorian

white leghorn control flock which has no special breeding behind it, this flock was still able to show a better profit figure than any of the local pure-bred flocks. Although too much reliance should not be placed on the results of any one test this result does suggest that scope exists for improving our local pure-bred stock and it is sincerely hoped that those hatcherymen now engaged in poultry breeding work will be rewarded for their efforts in the not too distant future.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the staff at Poultry Research Station and to Mr. F. A. E. Hunt for his preparation of the test results.

I am also indebted to Dr. M. R. Gardiner and Mr. I. Miller for making the post-mortem examinations on diseased birds, and to the Western Australian Egg Marketing Board for its co-operation in grading the eggs.

Table A
MORTALITY, BROODINESS AND BODY WEIGHT

Entries in Finishing Order	Breed	No. of pullet chick- officially starting test at 5 weeks of age	MORTALITY Based on No. of chicks alive at 8 weeks of age				No. of birds alive at conclusion of test (71 weeks and 3 days of age)	Broodiness recorded as the per cent. of birds housed at 21 weeks and 3 days which were broody one or more times	Incidence of Broodiness per entry	Average weight of birds in lb. at		
			9-21 weeks and 3 days		21 weeks and 3 days to 71 weeks and 3 days					21 weeks and 3 days of age	35 weeks of age	71 weeks and 3 days of age
			No.	Per cent.	No.	Per cent.						
1	W.L. x Aust.	48	2	4.2	12	25.0	34	2.2	1	3.39	4.74	5.06
2	do.	48	2	4.2	13	27.1	33	13.0	6	3.30	4.65	5.24
3	do.	48	5	10.4	10	20.8	33	13.9	14	3.37	4.77	5.27
4	do.	48	1	2.1	16	33.3	31	10.6	8	3.28	4.60	5.26
5	do.	48	4	8.3	15	31.2	29	6.8	5	3.41	4.89	5.34
6	do.	48	6	12.5	9	18.7	33	NH	NH	3.31	4.87	5.27
7	do.	47	2	4.2	16	34.0	29	8.9	10	3.38	4.82	5.38
8	do.	48	1	2.1	11	22.9	36	NH	NH	3.23	4.93	5.39
9	do.	48	6	12.5	8	16.7	34	2.1	1	3.28	4.84	5.21
10	do.	48	4	8.3	13	27.1	31	22.7	22	3.32	4.71	4.89
11	do.	48	2	4.2	14	29.2	32	10.9	7	3.35	4.90	5.25
12	do.	48	3	6.2	10	20.8	35	6.7	9	3.33	4.68	5.34
13	do.	48	6	12.5	11	22.9	31	11.9	9	3.38	4.69	5.35
14	do.	47	2	4.2	12	25.5	33	2.1	1	3.49	5.32	5.70
15	do.	48	5	10.4	16	33.3	27	4.2	2	3.23	4.76	5.11
16	White Leghorn	48	3	6.2	11	22.9	34	NH	NH	2.89	4.11	4.62
17	W.L. x Aust.	47	4	8.3	18	38.3	25	2.8	2	3.19	4.32	4.80
18	do.	48	1	2.1	19	39.5	28	1.1	11	3.11	4.39	5.41
19	do.	48	3	6.2	14	27.1	31	NH	NH	3.31	5.17	6.00
20	Australorp	48	1	2.1	11	22.9	36	10.6	10	3.81	5.56	6.11
21	W.L. x Aust.	48	7	14.6	18	37.5	23	7.3	3	3.27	4.44	5.00
22	White Leghorn	47	2	4.2	14	29.8	31	NH	NH	2.91	4.16	4.64
23	W.L. x Aust.	48	4	8.3	20	41.7	24	4.5	2	3.13	4.72	5.06
24	White Leghorn	48	1	2.1	10	20.8	37	NH	NH	2.73	4.26	4.49
25	W.L. x Aust.	47	6	12.8	18	38.5	23	9.7	5	3.34	4.77	5.26
26	White Leghorn	48	2	4.2	15	31.2	31	4.3	3	3.09	4.49	5.51
27	W.L. x Aust.	48	5	10.4	20	41.7	23	11.7	6	3.49	5.32	5.70
Total		1,291	90*	....	374	....	827	....	137	....	....	....
Average		47.8	3.3	7.0	13.9	28.9	30.6	6.0	5.1	3.26	4.69	5.22
Control	White Leghorn	48	1	2.1	11	22.9	36	NH	NH	2.50	3.72	4.22

* Excluding 5 chickens killed accidentally at the time of deworming.

Table B
EGG PRODUCTION AND CARCASS VALUES

Entries in finishing order	Age at first egg-days	Age to reach 50 per cent. lay-days	Eggs laid by entry in 50 weeks laying period	Eggs laid per bird alive		Eggs laid per bird for 50 weeks on a hen day basis	Average egg price per dozen	Value of eggs laid to end of test based on W.A. Egg Board gradations on a net return to farmer basis	Value of birds sold at 28. 3d. per lb. liveweight
				(a) At 8 weeks of age	(b) At 21 weeks and 3 days of age				
1	Days 152	Days 196	7,850	163.5	170.7	191.3	s. d. 3 11	£ s. d. 128 5 0	£ s. d. 19 7 0
2	139	191	7,971	166.1	173.3	191.5	3 10	127 10 10	19 9 3
3	136	204	7,230	150.6	168.1	189.9	3 11 1/2	119 4 4	19 11 6
4	139	198	7,190	149.8	153.0	186.3	4 0	119 9 2	18 6 9
5	137	189	7,443	155.1	168.0	200.5	3 10 1/2	120 18 1	17 8 9
6	155	208	6,747	140.6	160.6	180.2	3 11 1/2	112 0 0	19 11 6
7	137	204	6,605	140.5	146.8	181.3	4 0	110 8 7	17 11 0
8	168	208	7,020	145.1	149.4	175.5	3 10 1/2	113 2 11	21 16 6
9	169	204	6,821	142.1	162.4	168.6	3 9 1/2	112 6 4	19 18 3
10	142	200	6,723	140.1	152.8	178.8	3 10 1/2	108 17 6	17 0 11
11	153	196	6,765	140.9	147.1	174.3	3 11 1/2	111 18 5	18 18 0
12	138	203	6,689	139.4	148.6	166.8	3 11 1/2	109 6 11	21 0 9
13	138	203	6,506	135.5	154.9	175.1	3 10 1/2	105 15 5	18 13 6
14	161	210	6,598	140.4	146.6	162.1	3 11 1/2	108 6 9	21 3 0
15	153	199	6,076	126.6	141.3	173.9	4 0	101 5 11	15 10 6
16	159	213	6,214	127.5	136.1	153.2	3 10 1/2	100 14 2	17 13 3
17	136	201	5,911	125.8	137.5	168.4	3 11	96 5 9	13 10 0
18	137	221	6,133	127.8	130.5	153.9	3 11 1/2	101 0 9	16 11 11
19	160	204	5,613	117.0	124.7	158.3	3 11 1/2	92 12 4	20 16 3
20	159	214	5,089	126.9	128.5	139.1	3 11 1/2	100 19 5	24 15 0
21	142	199	5,535	115.3	135.0	173.0	3 9 1/2	88 2 10	12 18 9
22	139	203	5,729	121.9	127.3	148.8	3 9 1/2	90 11 11	16 4 0
23	137	203	5,417	112.9	123.1	164.3	3 11 1/2	88 16 9	13 13 5
24	151	220	5,590	116.4	118.0	134.6	3 10 1/2	90 3 1	18 13 6
25	166	205	5,195	110.5	126.7	165.5	3 9 1/2	82 9 7	13 12 3
26	140	218	5,120	106.7	111.3	134.9	3 11 1/2	84 12 7	19 4 9
27	152	226	4,927	102.7	114.6	152.0	3 10	78 13 10	12 5 3
Average	148	205	6,356	132.9	142.9	168.0	3 11	103 17 0	17 19 6
Control	171	229	6,669	138.9	141.9	155.3	3 7 1/2	101 12 8	17 2 0

Table C
EGG SIZE AND EGG GRADINGS

Entries in Finishing Order		Egg Size	Egg Gradings						
		Average egg weight of all eggs laid	16 lb. Export	14 lb. Export	16 lb. Local	14 lb. Local	12 lb. Local	Second Quality	Rejects
		oz.	%	%	%	%	%	%	%
1	.....	2.08	56.0	25.2	5.3	NH	8.4	4.9	0.2
2	.....	2.06	50.5	27.5	6.6	0.1	8.8	6.2	0.3
3	.....	2.03	52.7	27.8	6.5	NH	10.4	2.5	0.1
4	.....	2.08	53.2	26.8	8.1	NH	8.8	2.4	0.7
5	.....	2.03	52.4	27.9	5.8	0.1	8.3	5.2	0.3
6	.....	2.09	55.2	25.2	7.6	NH	8.0	3.1	0.9
7	.....	2.08	54.1	27.6	8.0	0.3	7.4	2.3	0.3
8	.....	2.08	54.9	25.8	7.4	0.1	7.0	4.7	0.1
9	.....	2.09	51.9	28.6	8.7	0.1	6.4	3.9	0.4
10	.....	2.04	53.5	26.4	3.6	0.2	12.5	3.6	0.2
11	.....	2.09	52.2	26.1	9.0	NH	8.6	4.1	NH
12	.....	2.11	51.0	25.0	10.9	NH	8.3	4.2	0.6
13	.....	2.09	50.6	23.8	10.1	0.2	9.9	5.1	0.3
14	.....	2.11	49.0	26.7	12.1	0.6	5.3	5.9	0.4
15	.....	2.08	54.3	26.1	8.5	0.2	8.3	1.8	0.8
16	.....	2.09	55.1	26.1	6.0	0.1	8.9	3.5	0.3
17	.....	2.03	50.9	27.3	4.7	0.3	12.4	4.4	NH
18	.....	2.15	53.3	19.4	17.1	0.1	5.4	4.5	0.2
19	.....	2.17	56.0	16.9	18.1	0.3	3.7	4.5	0.5
20	.....	2.03	47.9	32.7	6.8	0.1	9.4	3.0	NH
21	.....	2.00	46.3	28.4	4.9	0.1	14.1	5.7	0.5
22	.....	2.02	49.7	31.0	4.0	NH	9.2	4.8	1.3
23	.....	2.02	46.4	30.9	7.9	0.1	10.3	3.5	0.9
24	.....	2.03	57.8	27.4	3.8	NH	6.0	5.0	NH
25	.....	2.00	44.9	27.9	8.6	0.1	12.5	5.2	0.8
26	.....	2.15	60.0	18.9	13.3	NH	3.2	4.2	0.4
27	.....	1.96	43.1	29.8	5.2	0.4	17.3	4.2	NH
Average		2.06	52.1	26.4	8.0	0.1	8.9	4.1	0.4
Control		1.92	32.7	41.3	1.8	0.2	17.9	5.4	0.7

HIGHEST AND LOWEST EGG PRICES PREVAILING DURING 1960 FOR ABOVE GRADES

Price per doz. on a nett return to farmer basis	1st April to 8th May	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
		5 0	4 4	4 10	4 2	3 6	1 8	....
	5th Sept. to 27th Nov.	3 6½	2 11½	3 4½	2 9½	2 2½	7½	....

Table D
FOOD CONSUMPTION

Entries in finishing Order	Weight of food consumed from 8 weeks of age, excluding greenfeed which was fed at the rate of 1½ oz. per bird per day during the laying period	Value of feed consumed from 8 weeks of age	Average weight of feed consumed per bird from 21 weeks and 3 days of age, excluding greenfeed	Average food consumption per bird per day during		Feed eaten per dozen eggs laid from 21 weeks and 3 days of age, excluding greenfeed	Feed eaten per lb. of eggs produced from 21 weeks and 3 days of age, excluding greenfeed
				9-21 (13 3/7 week period)	21 3/7-71 3/7 weeks (50 week laying period)		
	lb.	£ s. d.	lb.	oz.	oz.	lb.	lb.
1	4,633.61	73 18 5	92.7	2.95	4.24	5.82	3.73
2	4,755.01	75 17 0	93.8	3.02	4.29	5.88	3.85
3	4,264.39	67 18 1	91.9	3.03	4.20	5.69	3.73
4	4,263.65	67 17 8	88.8	3.00	4.06	5.88	3.69
5	4,321.00	68 17 4	94.4	2.97	4.32	5.66	3.72
6	4,268.92	67 19 9	79.9	3.02	3.94	5.80	3.77
7	4,185.29	66 13 1	92.6	3.00	4.24	6.12	3.92
8	4,544.58	72 9 6	93.0	2.95	4.25	6.36	4.08
9	4,391.60	70 0 3	88.4	2.98	4.04	6.29	4.02
10	4,072.75	64 15 11	86.2	3.02	3.94	5.80	3.77
11	4,433.79	70 9 7	92.5	3.07	4.23	6.39	4.07
12	4,484.00	71 8 5	90.6	3.04	4.14	6.52	4.12
13	4,255.76	67 3 2	92.5	2.95	4.23	6.35	4.06
14	4,744.00	75 14 0	96.0	3.06	4.39	7.11	4.08
15	3,839.28	61 17 1	88.2	2.93	4.03	6.08	3.83
16	4,130.39	65 17 0	83.1	2.72	3.80	6.51	4.15
17	3,796.87	60 7 9	85.9	2.90	3.93	6.11	4.07
18	4,280.69	68 4 10	87.5	2.82	4.00	6.83	4.24
19	4,234.27	66 18 0	95.6	3.02	4.37	7.25	4.45
20	4,988.06	79 9 6	92.3	3.39	4.22	7.96	5.22
21	3,582.67	56 17 4	86.6	2.96	3.96	6.01	4.01
22	4,004.82	63 16 5	84.7	2.75	3.87	6.81	4.49
23	3,730.86	59 4 10	88.8	2.89	4.06	6.49	4.27
24	4,149.00	66 14 10	76.2	2.56	3.77	7.36	4.82
25	3,621.00	57 9 9	96.0	3.03	4.10	6.49	4.32
26	4,172.69	66 10 0	89.9	2.80	4.11	7.95	4.92
27	3,522.77	55 18 5	96.0	3.06	4.39	7.11	4.03
Average	4,211.91	67 1 0	89.7	2.94	4.10	6.41	4.14
Control	3,967.62	63 8 4	77.4	2.32	3.54	5.95	4.16

Table E
FINANCIAL SUMMARY OF RESULTS AT END OF TEST ON A PER BIRD
ALIVE AT 8 WEEKS BASIS

Entries in finishing order	Breed	Value of eggs laid	Live weight value at 2s. 3d. per lb.	Income from sale of eggs and birds	Cost of feed from 8 weeks	Profit for each bird alive at 8 weeks
		£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.
1	W.L. x Aust.	2 13 5	8 1	3 1 6	1 10 10	1 10 8
2	do.	2 13 2	8 1	3 1 3	1 11 7	1 9 8
3	do.	2 9 8	8 2	2 17 10	1 8 4	1 9 6
4	do.	2 9 9	7 8	2 17 5	1 8 3	1 9 2
5	do.	2 10 4	7 3	2 17 7	1 8 8	1 8 11
6	do.	2 6 8	8 2	2 14 10	1 8 4	1 6 6
7	do.	2 6 11	7 6	2 14 5	1 8 4	1 6 1
8	do.	2 7 2	9 1	2 18 3	1 10 3	1 6 0
9	do.	2 6 10	8 3	2 15 1	1 9 2	1 5 11
10	do.	2 5 4	7 1	2 12 5	1 6 11	1 5 6
11	do.	2 6 7	7 11	2 14 6	1 9 4	1 5 2
12	do.	2 5 7	8 9	2 14 4	1 9 9	1 4 7
13	do.	2 4 1	7 9	2 11 10	1 8 0	1 3 10
14	do.	2 6 1	9 0	2 15 1	1 12 2	1 2 11*
15	do.	2 2 2	6 6	2 8 8	1 5 9	1 2 11*
16	White Leghorn	2 2 0	7 4	2 9 4	1 7 5	1 1 11
17	W.L. x Aust.	2 1 0	5 8	2 6 8	1 5 8	1 1 0
18	do.	2 2 1	6 11	2 9 0	1 8 5	1 0 7
19	do.	1 18 7	8 8	2 7 3	1 7 10	19 5
20	Australorp	2 2 1	10 4	2 12 5	1 13 2	19 3
21	W.L. x Aust.	1 16 8	5 5	2 2 1	1 3 8	18 5
22	White Leghorn	1 18 6	6 11	2 5 5	1 7 2	18 3
23	W.L. x Aust.	1 17 0	5 8	2 2 8	1 4 8	18 0
24	White Leghorn	1 17 7	7 9	2 5 4	1 7 10	17 6
25	W.L. x Aust.	1 15 1	5 10	2 0 11	1 4 6	16 5
26	White Leghorn	1 15 3	8 0	2 3 3	1 7 8	15 7
27	W.L. x Aust.	1 12 9	5 1	1 17 10	1 3 3	14 7
Average	.....	2 3 5	7 7	2 11 0	1 8 1	1 2 11
Control	.....	2 2 4	7 1	2 9 5	1 6 5	1 3 0

NOTE.—The laying period was the same for all entries covering 350 days.

* Shared 14th place.

Table F
CAUSES OF DEATH FROM DAY-OLD TO 71 WEEKS AND 3 DAYS
(APPROX. 10 WEEK INTERVALS)

Disease	0-8 weeks	9-21 3/7 weeks	21 4/7-31 weeks	32-41 weeks	42-51 weeks	52-61 weeks	62-71 3/7 weeks	Total
Bluecomb	5	.....	.....	.....	.....	.....	.....	5
Cystic Yolk Sac	1	.....	.....	.....	.....	.....	.....	1
Omphalitis	9	.....	.....	.....	.....	.....	.....	9
Accidental	3	5	.....	.....	.....	.....	.....	8
Unknown	15	17	12	3	1	4	1	53
Crop Impaction	1	1	.....	.....	.....	.....	.....	1
Peritonitis	.....	.....	3	.....	.....	.....	4	8
Fowl Paralysis	.....	57	56	43	31	16	16	219
Fowl Paralysis and Visceral Leucosis	.....	4	3	3	5	2	1	18
Visceral Leucosis	.....	10	12	24	23	27	50	146
Tumour of Leucotic Origin	.....	.....	.....	.....	.....	1	.....	1
Fatty infiltration of liver	.....	.....	.....	.....	.....	.....	1	1
Dilation of Proventriculus	.....	1	.....	1	.....	.....	.....	2
Caecal Impaction	.....	.....	1	.....	.....	.....	.....	1
Gizzard Impaction	.....	.....	.....	2	2	1	.....	5
Jaundice	.....	.....	.....	1	.....	.....	.....	1
Folliculitis	.....	.....	.....	1	.....	.....	.....	1
Nephritis	.....	.....	.....	.....	1	1	1	3
Protrusion of oviduct	.....	.....	.....	1	.....	.....	.....	1
Chronic Intestinal Coccidiosis	.....	.....	.....	.....	2	.....	.....	2
Worm Infestation	.....	.....	.....	.....	.....	2	5	7
Leucotic Ovary	.....	.....	.....	.....	.....	1	.....	1
Total	34	95	87	79	66	57	80	498

NOTE.—The 34 chickens which died in the 0-8 weeks period represented 2.10 per cent. of the 1,620 chickens taken into the test at day old.

In addition to the 34 chickens which died during the first 8 weeks, 17 cockerels (1.05 per cent.) were removed at 8 weeks and 273 pullet chicks were balloted out. This left 1,296 pullet chicks to start the test at 8 weeks. However 5 pullets were killed through deworming during the growing period which meant that 1,291 pullet chickens officially started in the test at 8 weeks.

Of these 1,291 chickens 90 or 6.9 per cent. died during the 9-21 weeks and 3 days period and 369 or 28.8 per cent. died during the 21 weeks and 3 days to 71 weeks and 3 days period.

* The majority of birds included in the unknown deaths were birds which died during week-ends and which were unsuitable for pathological examination.

Further Fertiliser Trials

with Potatoes on Karri Loam Soils

By J. P. FALLON, B.Sc. (Agric.), Adviser (Vegetables); M. HARDIE, Vegetable Instructor; and G. C. DE HAAN, Vegetable Instructor

A FURTHER trial in a series of fertiliser experiments being conducted on potato growing areas in Western Australia was planted in August, 1959, at Pemberton. Results of the trial are generally consistent with those of the three previous trials conducted on similar soil types in the area, and have added further to our knowledge of the fertiliser requirements of the red karri loam soils, which are becoming of increasing importance for potato growing.

The site selected was newly cleared land on the property of A. R. Kelly and Son at Pemberton. Although perhaps a little more gravelly than the normal red karri loam soils of the district, the soil type was broadly typical of the potato growing land in the area.

In this trial the following rates of fertiliser were used:—

Ammonium Sulphate 3, 6 and 9 cwts. per acre.

Superphosphate 12, 18, 24 and 27 cwts. per acre.

Muriate of Potash 0, 2 and 4 cwts. per acre.

All possible combinations of these fertiliser constituents were applied giving 36 treatments, which were replicated 4 times.

Each plot in the trial contained 3 rows of potatoes with 37 plants per row. The crop was planted using a ridger to open three furrows at a time and all fertiliser was applied in a band in the furrow at time of planting. This method of planting is generally used in the district.

During the growing period the crop was sprinkler irrigated whenever rainfall was insufficient to maintain a satisfactory soil moisture level. Details of rainfall and irrigation for the growing period are as follows:—

Rainfall—	Points.
August	518
September	293
October	329
November	355
December	181

Irrigation—	
October 26th	100
November 8th	100
November 19th	100
December 15th	100
December 23rd	100

Planting commenced on 24th August and was completed in 3 days. No rain was received in August after planting.

Inspections of the crop were carried out periodically during the growing period. Symptoms of potash deficiency became evident quite early in plots receiving high applications of nitrogen and low rates of



1.—Planting the trial. Various rates of fertiliser may be seen in the furrows



2.—General view of planting operations, showing 3-furrow ridger in foreground

potash. Affected plants developed a typical blue green colour. Leaves were puckered and bronzed and were brittle rather than soft and flat as in normal plants. There was also a high incidence of the fungous disease *rhizoctonia*, which apart from showing typical symptoms in mature plants caused a somewhat uneven germination. Seed used to plant the crop had not been dipped for control of *rhizoctonia*, but showed little evidence of tuber borne sclerotes.

Harvesting of the trial commenced on the 18th January, 1960. It was found that there was generally a high percentage of second growth and badly shaped tubers. This ranged from 23 per cent. to 43 per cent. of total yield and such losses are not uncommon in the district for this planting. It is believed that some of this second growth was due to the incidence of *rhizoctonia* which it is considered could be attributed largely to the method of planting used. It has been pointed out that the accepted practice in the Manjimup and Pemberton districts is to plant spring potato crops in furrows opened by a plough or ridger. The setts are usually dropped into the furrow and fertiliser applied directly without first covering the setts or attempting to push them into the side of the furrow. This same technique was used in planting this trial in order to adhere as closely as possible to local practice. It is claimed by growers that during the cooler weather at this time of the year, fertiliser burn on the potato setts is unlikely. Although this may be true, it is considered by the authors that under these conditions developing shoots are almost

certain to suffer some damage when growing into raw fertiliser materials. This means that the shoots start off very early in life with an injury into which *rhizoctonia* organisms, which appear to be ever present, can find entry.

In all future trials care will be taken to keep fertiliser materials away from potato setts and growers are strongly recommended to do likewise.

Yields per acre from the plots ranged from 8 tons 16 cwts. to 16 tons 2 cwts. Potatoes were graded into 1st and 2nd grade. Tubers slightly damaged due to digging, but which were otherwise 1st grade were included in the 1st grade sample. Tubers with second growth or which were undersize were included in 2nd grade as were also any cracked or misshapen tubers. It is interesting to note that the highest percentages of second grade tubers were associated with maximum rates of application of nitrogen and lack of potash. The effects of nitrogen, phosphate and potash are briefly summarised hereunder:—

1. **Nitrogen.**—Ammonium sulphate was found to give significantly higher yields with increasing levels of application. In the three previous trials there was no response to increasing applications of sulphate of ammonia at rates higher than 6 cwts. per acre. However, previous trials did not receive as much water in the form of rainfall or irrigation and it is possible that the higher nitrogen requirement up to 9 cwts./acre is associated with the increased irrigation.



3.—Experimental crop in early stage of growth. Hilling up in progress



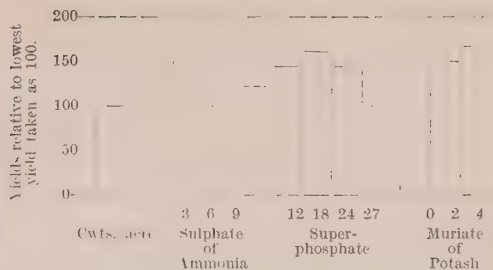
4.—General view of an experimental crop in the Pemberton district

2. Phosphate.—Increasing the application of superphosphate from 12 to 18 cwts. per acre gave a significantly higher yield, but there was no significant difference in yields where rates of superphosphate greater than 18 cwts. per acre were applied. However, there is a trend towards increased yield up to 24 cwts. per acre. Only in one previous trial (1958-59) was a significant response to 24 cwts. per acre of superphosphate obtained, although all trends have included rates up to or exceeding this amount.

3. Potash.—Although there were no significant differences between applications of potash at 2 and 4 cwts. per acre, both these rates gave significantly better yields than where no potash was applied. A tabulation and diagram showing responses follow:—

Effect of Fertiliser Applications on Fields

Fertiliser Application		Total Yield/Acre	First Grade Yields	Yields relative to lowest yield taken as 100/
Sulphate of Ammonia (cwts./acre)	3	14.6	10.1	102
	6	17.4	12.4	148
	9	18.9	13.2	164
Superphosphate (cwts./acre)	12	16.2	11.4	128
	18	17.1	12.1	142
	24	17.1	12.8	156
	27	17.5	12.3	146
Muriate of Potash (cwts./acre)	0	15.4	10.0	100
	2	17.6	12.7	154
	4	17.9	13.1	162



In a subsequent article the results of all potato fertiliser trials conducted on red karri loam soils will be summarised and suggestions for amended fertiliser practices will be made.

ACKNOWLEDGMENTS

The co-operation of Messrs. A. R. Kelly and Son in conducting the trial is gratefully acknowledged. Thanks are due to the Biometrics Section of the Plant Research Division for the statistical analysis.

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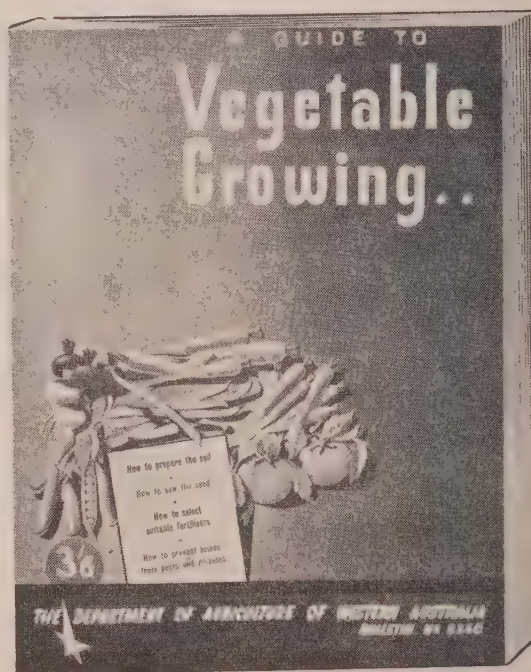
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Correcting

COBALT DEFICIENCY

By L. C. SNOOK, D.Sc., Animal Nutrition Officer

COBALT is essential in the food eaten by sheep and cattle. As little as one part of cobalt in 10,000,000 parts of food appears to be adequate. But if this mere trace is missing, ruminants will waste away and die, even when the feed appears excellent in every other way.

For many years it was considered that cobalt deficiency in Western Australia was confined to the coastal areas. It is now apparent, however, that quite serious losses are occurring over extensive areas where the cobalt deficiency is only marginal. In many cases, the pastures contain enough cobalt to maintain adult stock in apparent good health, but there is not enough present for the well-being of young animals. Quite a lot of unthriftiness in lambs and calves could be a direct result of sub-optimal intakes of cobalt. Even the apparent good health of the adults may be a delusion. Border-line deficiencies can be costly, for the very reason that symptoms are not obvious, although production is at a lower level than otherwise would be obtained. A deficiency on one farm was discovered for example, while seeking the cause of frequent cases of ketosis or acetonemia in the cows. The loss of appetite which precipitates this disease was apparently due to a partial deficiency of cobalt. In a beef herd at Mayanup, an infertility problem appears to have been overcome with cobalt supplements. On an adjacent farm the growth rate of the lambs has improved following the application of cobalt. At Cranbrook, a weaner problem was cured in a fortnight following the use of cobalt drench. At Mt. Barker, lack of size in a stud flock appears to be due to a partial lack of cobalt in the pasture.

Analyses of liver and blood from suspect properties are confirming the suspicion that border-line cobalt deficiency may occur in many so-called "sound" areas. Where young stock, in particular, fail to thrive on what appears to be good feed, the possibility of cobalt deficiency should be considered.

Stock suffering from cobalt deficiency show many of the symptoms associated with worm infection. In fact such animals often carry a heavy worm burden because the unthriftiness associated with cobalt deficiency makes them particularly susceptible to infection with worms. This type of unthriftiness can be prevented by making sure that all young stock receive adequate cobalt.

Cobalt bullets provide farmers with an excellent diagnostic tool where cobalt deficiency may be suspected. If cobalt bullets are given to half of a line of unthrifty weaners or calves, the treated animals will quickly respond if cobalt is needed. If, within two or three weeks, no difference is apparent between the two groups, then it can be accepted that lack of cobalt is not the main cause of the unthriftiness.

Cobalt deficiency can be overcome cheaply and simply by the use of superphosphate containing cobalt. This costs only 44s. per ton more than ordinary super and contains enough cobalt to correct any deficiencies if applied once every three years. The extra cost is trivial and no

extra labour is involved. In deficient areas the farmer should buy superphosphate containing cobalt every third year. Alternatively, each year one-third of the fertiliser should contain cobalt. Each bag of cobalt superphosphate contains about 7 ozs. of cobalt sulphate for an additional cost of 4s. The private individual cannot buy cobalt salt as cheaply as this, so nothing is gained by "mixing one's own," or applying the cobalt in any other form. Cobalt is not a plant food but there are many advantages in treating the pastures. This means that every animal grazing on the pasture necessarily obtains adequate amounts of cobalt. All the work involved in the administration of cobalt bullets is thereby eliminated and there is no worry about unthriftiness in animals which reject the bullets.

Much has yet to be learnt about the frequency with which cobalt must be applied to correct deficiencies in a pasture. On deep coastal sands 2 ozs. of cobalt sulphate per acre is just about enough for 2 years. At the Bramley Research Station, pasture treated with 2 ozs. per acre contained an abundance of cobalt for 2 years,

but was borderline in the third year. Cobalt superphosphate contains almost 7 ozs. of cobalt sulphate per bag and this should be a generous allowance for three years under most conditions. Whenever the farmer has doubts in this regard he should consult his District Adviser.

Emphasis has been given in this talk to the cheapness and effectiveness of using cobalt superphosphate to correct cobalt deficiency. Where top dressing is not carried out, other methods have to be used. The use of cobalt bullets is now widespread. Salt licks can also be used by adding 1 oz. of commercial cobalt sulphate to each 100 lb. of lick. When drinking water can be treated by adding 1 oz. of cobalt sulphate to each 10,000 gallons of water, the cost is negligible—a mere 30s. per annum for each thousand sheep.

Before concluding, emphasis can again be given to the seriousness of the losses which occur when sheep and cattle are on rations deficient in cobalt. Any risk of a lack of this essential element can be eliminated cheaply and easily where cobalt superphosphate can be used as a fertiliser.

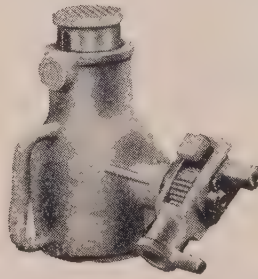
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BROOM MILLET

IN

THE MARKET GARDEN

By J. P. FALLON, B.Sc. (Agric.), Adviser (Vegetables)

WHEN we think of broom millet we usually regard it as a crop for growing either under flood irrigation or in summer moist swamps for the sole purpose of producing straw for brooms. However, the particular characteristics of the broom millet plant make it adaptable for use in the market garden as an excellent windbreak and rotation crop.

For those people who are not familiar with broom millet, it may be described as an annual grass which grows rapidly during warm weather provided that adequate moisture is available. Under favourable conditions it will grow to a height of 8 to 9 ft. in a very short period. This ability of rapid growth combined with a strong stem which will stand erect even after the plant has passed maturity makes it ideally suitable for use as a windbreak crop.

Broom millet has a number of advantages over other types of windbreaks in that it may be planted with the particular crop it is designed to shelter and will very readily out grow the crop and hence give adequate protection. It is extremely easy to grow and is cheap as regards the amount of seed and labour needed to produce such



2.—Close up view of broom millet crop. Seed heads are being bent over to initiate curing and ensure straight straw

effective protection. It is also relatively easily removed when desired.

Many of the windbreaks used in market gardens such as timber face cuts, palm fences or corrugated iron have the disadvantage that unless they are carefully constructed, as well as protecting the crop from wind, they are inclined to prevent air circulation. In the winter such permanent shelters are inclined to hold in cold air and retard growth.

Broom millet is effective in cutting down the force of the wind yet allows a gentle filtering action which keeps air circulating through the crop and assists in the prevention of a number of disorders. If desired, the crop can be topped to remove the seed heads and the stems will remain standing as a satisfactory shelter for many months.



1.—An effective windbreak of broom millet around an experimental tomato plot at the Vegetable Research Station, Herdsman Lake

The seed of broom millet may be sown through a small hand operated seeding machine in the same way as onion or carrot seed would be sown. Thinning of the stand after emergence is an advantage, in order to obtain the maximum growth and height of the windbreak. Thinning down to 9 inches between clumps of plants is generally satisfactory. Those growers who are interested in harvesting the straw from their broom millet windbreaks will find that there is a ready market for the crop as at present all straw for locally made brooms is imported. Although the return per acre for straw from broom millet cannot be compared with the return from good quality vegetable crops, the fact that the crop is saleable makes it an attractive and profitable rotation or wind-break crop in the market garden. Broom millet straw is valued at approximately £100 to £120 per ton, and a good crop under sprinkler irrigation could produce up to 1 ton of straw per acre. Plantings for straw production should be made not later than September, however seed could be sown at any time during the spring and early summer for windbreak or rotation crops.

In the past, market gardeners in this State have been able to justify to some extent a minimum amount of rotation by the frequent use of heavy quantities of organic manures. In the future however, it would appear certain that with increasing mechanisation, the shortage of organic manures and more extensive holdings that the introduction of special rotation crops will be essential. Broom millet is only one of a number of crops which could serve both as a valuable rotation crop and windbreak, but is one of the few which can



3.—Showing length and quality of straw

be used for these purposes and still return a profit.

In the not far distant future, it could be quite a common sight to see neatly laid out market gardens with plots of vegetables interspersed with plantings of such crops as broom millet.

Should any growers be interested in harvesting straw from broom millet crops, they are advised to contact officers of the Department of Agriculture in order to obtain advice on the methods of cutting and curing the crops.



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VITAMINS

and their RELATIONSHIP to ANIMAL HEALTH

By J. SHILKIN, B.V.Sc., Asst. Chief Veterinary Surgeon

NUTRITIONAL problems are assuming more and more importance in stock as the years progress and while much stress is sometimes placed on the role of vitamins in nutrition, one should not lose sight of the fact that they are only part of a balanced ration which should include other constituents, such as proteins, carbohydrates and fats in suitable proportions.

Nevertheless, vitamins are important constituents of the diet and although they are only required in minute quantities, deficiencies of any of them may give rise to serious disease conditions and in some cases, even death.

Generally speaking, the vitamins which are likely to be deficient in livestock are vitamins A, and the B complex, D, E and K, and as they have different uses in the body and consequently their deficiencies will produce different symptoms, it would be as well if we considered them separately.

AN IMPORTANT ROLE

Vitamin A, as well as being first on the list, is also one of the most important in relation to animal health. It can be obtained from the livers of salt-water fish, birds and mammals and much of it is obtained in the form of shark liver oil. It is readily oxidised and as a result, easily destroyed, particularly in the presence of heat, so that care is obviously necessary in dealing with vitamin A preparations. Cod liver oil, for example, will retain its potency in the bottle for long periods but when mixed with feed will deteriorate rapidly due to this oxidation process. Much vitamin A is destroyed too in the ordinary

field curing of hay, and the admixture of trace minerals which is commonly practiced these days also speeds up the oxidation process.

In the body, vitamin A is absorbed from the small bowel and stored in the liver and, for this reason, animals fed on rations that are deficient in vitamin A may not show any obvious symptoms for several months, depending, of course, on the amount previously stored.

Its main functions are those relating to the development of epithelial tissue of all kinds in the body and this includes the cells of the skin and the lining of all other tissues such as that of the respiratory tract, bowel wall, breeding tract, eyes, etc. It is also necessary for normal growth of bone.

With such all-embracing functions, the results of any deficiency may easily be seen—the weakening of the dependent tissues may lead to respiratory infections, bowel infections, eye and skin diseases, abortions and paralysis resulting from bone abnormality, particularly of the spinal column.

In cattle and sheep, owing to the capacity of the liver for storage, vitamin A deficiency is uncommon and usually only

occurs in drought time when there is no fresh green feed or when they are hand-fed on concentrates with insufficient hay, or hay of poor quality. In calves, feeding on skim milk before they eat pasture may produce symptoms of deficiency.

In pigs, vitamin A deficiency is a relatively common occurrence, particularly where they are fed on boiled garbage and concentrated food without green feed. Paralysis, particularly of the hindquarters, is often an early result of this type of feeding. Other symptoms in pigs that may be associated with vitamin A deficiency are watery eyes, blindness, either partial or complete, sterility, abortion, the birth of abnormal piglets, dermatitis and sudden deaths.

Poultry are also extremely susceptible to vitamin A deficiency and here again paralysis and respiratory infections are commonly seen.

The feeding of poor quality chaff or prolonged droughts may also cause deficiency symptoms in horses and deficient rations may also cause trouble in dogs and cage birds.

Vitamin A is obviously then a very important food constituent and every care should be taken to ensure that animals of all kinds are adequately supplied.

THE VITAMIN B COMPLEX

The vitamin B complex, as this group of compounds is called, was once thought to be one vitamin. Now, however, it is known to be made up of a large number of separate vitamins, each with different functions. The most important of this group in animal and human nutrition are:—

- (1) B₁, also known as Thiamin or Aneurin.
- (2) Riboflavin or B₂.
- (3) Nicotinic Acid or Niacin.
- (4) Pyridoxin or B₆.
- (5) Pantothenic Acid.
- (6) Choline.
- (7) Biotin.
- (8) Para aminobenzoic acid.
- (9) Vit. B₁₂—also known as the Animal Protein Factor.

Most of this group of compounds are not important in the ruminants such as sheep, goats and cattle as they are synthesised in the alimentary tract by bacterial action.

However, symptoms of vitamin B₁ deficiency may occasionally occur in pigs and dogs. In pigs, particularly during pregnancy and lactation, deficiency may cause loss of appetite, wasting, leg weakness and heart failure. In dogs fed entirely on cooked or canned meats, symptoms very similar to those of the condition known as beri beri in humans may occur.

As the B₁ requirements of cats are four times that of dogs, deficiency is more likely to occur in this species. A reddish colouration of the gum at the junction with the teeth often appears as the earliest sign of thiamin deficiency. Loss of appetite, weight, vomiting, excessive salivation, inco-ordination and prostration are other symptoms that have been seen in cats.

Nicotinic acid deficiency does not occur in ruminants but in pigs deficiency readily occurs on a diet of skim milk or maize or other cereal products. In such cases, there is loss of appetite, diarrhoea and possibly paralysis. A condition in dogs known as Black Tongue in which there is diarrhoea and ulceration of the tongue is considered to be due to a Nicotinic Acid deficiency and in cats the symptoms are somewhat similar.

Deficiencies of most of the other vitamins of this group are unlikely to occur except on experimental rations but vitamin B₁₂ has become of considerable interest and importance in recent years. It is essential for tissue regeneration and for the full utilisation of carbohydrates and proteins and it is concerned in growth, blood formation and in the normal functioning of the liver and the nervous system. Deficiency will cause a failure to thrive and grow, certain breeding problems and it may play a part in a number of the metabolic conditions, such as milk fever, acetonaemia and pregnancy toxæmia.

Vitamin B₁₂ is synthesised in the rumen of cattle and sheep but for this purpose cobalt is essential. Where this is deficient, therefore, symptoms which can more correctly be attributed to vitamin B₁₂ deficiency, are likely to occur.

Vitamin C, whilst important in human nutrition, does not appear to be very important in animals as most of them synthesise it in their bodies.

Vitamin D, however, is a very important one. Fortunately, direct sunlight is the most potent source of this vitamin, so that

deficiencies are most likely to occur only where sunlight is inadequate and in most areas of this State, this should not really be a problem. However, it is possible for vitamin D deficiency to occur even when vitamin D supplies are adequate but where there is a gross inbalance of calcium and phosphorus in the diet as metabolism of these minerals in the body is initially bound up with vitamin D.

The most important disease condition associated with vitamin D deficiency is the well known "Rickets" which may occur in the young of most animals.

Vitamin E also appears to be an important vitamin in animals and poultry and deficiencies in some animals and birds are not infrequently seen.

It is possible to induce a vitamin E deficiency by feeding large amounts of cod liver oil which has a tendency to inactivate vitamin E.

In poultry, deficiency may be responsible for several serious conditions, particularly

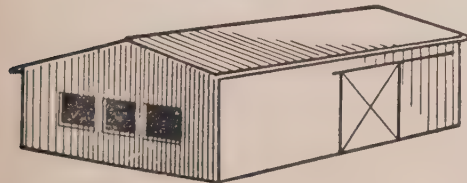
in young chickens and in calves and lambs it may produce a type of muscular weakness known as White Muscle disease. Vitamin E also has some effect on heart muscle and in some heart conditions in animals, particularly dogs and cats, it appears to be very useful. It is thought to play some part in sterility in animals but there is still a good deal of uncertainty on this point.

The only other vitamin which may be considered of some importance in relation to animals in the present date of our knowledge is vitamin K and in chickens, deficiency of it may cause a haemorrhagic disease which can cause considerable mortality in chickens.

From this brief review it can be seen that vitamins may play quite an important part in animal nutrition but it can be taken for granted I feel sure, that as time goes on much more information relating to their effects will be accumulated both in Australia and overseas.

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CASTOR BEANS

Ricinus communis Linn

By T. PAVY, B.Sc. (Agri.), Agricultural Adviser

MANY people have seen the wild castor oil plants around the metropolitan area, growing in rubbish dumps, and waste lands. But they have not realised that the demand for castor oil has been increasing over the last 15 years. Although one of its main uses is in the lubrication of jet engines, it is also used in plastics, special low temperature lubricants, hydraulic fluids, paints, varnishes, textiles and pharmaceuticals.

DESCRIPTION

The castor oil plant, *Ricinus communis* Linn. of the family *Euphorbiaceae*, in its wild state is a tall perennial plant. These are unsuitable for mechanical harvesting, due to their tallness, and to the fact that most of them shed their seeds, although the author has seen some plants that did not dehisce, in fact it was very hard to break open the capsule.

The castor oil plant—an evergreen tree or tall shrub, is 3-15 feet tall. Leaves alternate palmate, deeply 5—many lobed, 1-2 feet in diameter, green or reddish, petioles 10-15 inches in length with conspicuous glands. Flowers without petals, unisexual, in a stout, erect, terminal raceme, the male in the lower portion, the female above. Male flowers $\frac{1}{2}$ inch in diameter, shortly pedicellate, with membranous calyx splitting into 3-5 valvate segments, stamens numerous, the filaments crowded and much branched, anther cells distinct, subglobose. Female flowers with a spathaceous caducous calyx nearly as long as that of the male flower, ovary 3-celled each loculus with one ovule, styles three, long or short, spreading, usually bifid, often very large, feathery or papillose, frequently deep red. Capsule smooth or covered with soft brown spines, dehiscent, splitting into three 2-valved cocci $\frac{1}{2}$ -1 inch long, globuse or ovoid. Seed ovoid with large caruncle. Seed-coat crustaceous, smooth and mottled. Cotyledons broad, cordate or ovate, flat. Endosperm fleshy and oily.

OIL DEVELOPMENT

The oil is laid down very slowly in the first 30 days of seed formation, but increases rapidly in the next 10-20 days. In

50-60 days after decernability the rate is doubled and about 80 per cent. of the total oil is deposited. Thus this indicates the period when castors require maximum nutrition. They should not be under water stress at any period. The oil content continues to increase for 30 days after the dry stage. Therefore harvest can be delayed to 20-30 days after drying of the fruit. This is important for mechanical harvesting, as all the fruits do not ripen together, and, if they do not dehisce, the first fruits can be left on the plant for a month while the others ripen up.

The oil content of the seed is not affected by storage, and having a hard test, storage is easy. Added to this no insect or disease attacks the seed in storage. (At "Bundidup" rats and mice seemed to thrive on them.

Overseas work with Castors show:—

(1) **Climate.**—Castor, which does not tolerate frosts, is a summer growing plant, needing soil temperatures of 58° F. to germinate.

(2) **Soils.**—Castors can be grown on any type of soil except very heavy clay, although soils of high fertility produce rank vegetative growth with lower yields of fruit. Soils that have the ability to warm up quickly in the spring are ideal. They should have a free draining soil, as castors do not like wet feet.

(3) **Sowing.**—Seed can be drilled or sown by hand.

(4) **Seeding Rate.**—Depends on seed size, and ranged from 12-15 lb./ac.

(5) **Spacing.**—Generally three ft. rows with seed 18 in. in the rows, although this varies in different localities.

(6) **Irrigation.**—Castors respond to irrigation. Needing 3-3½ acre feet of irrigation without rain or moist ground is unavailable.

(7) **Manuring.**—Soils high in N. are not suitable for castors as this produces excessive vegetative growth. Castors should not follow a legume crop for this reason. On other soils apply 18-36 lbs. Nitrogen, 45-63 lbs. super, 45-67 lbs. potash per acre.

(8) **Harvesting.**—Where harvesting is done by hand, the worker uses a bag similar to an apple-pickers bag. Then by cupping both hands around the spike, he scrapes the fruit into the bag. By this method a worker can harvest 1,000 lbs. of Castors per day.

In the United States of America in certain areas, they have special Castor harvesters, costing £2,500. Harvesting is done by beaters which knock the matured capsules and seed onto a tray from which they are elevated to a hulling and cleaning mechanism. Latest information received, states that special equipment has been developed to adapt conventional harvesters for castor bean crops.

(9) **Yields.**—These range from 800 lb./ac. in India to nearly 3,000 lb./ac. in the United States of America.

(10) **Oil Content.**—In the United States of America, with dwarf varieties, oil content varies from 40 per cent. to 50 per cent. oil.

(11) **Disease.**—Many varieties are attacked by a variety of insect pests,

bacterial and fungal disease, attacking various parts of the plant and fruits, all leading to lower yields. At "Bundidup," the only pest attack was the wireworm attack on seedlings. There was no other pest or disease found on any plant. Even though capeweed nearly was covered with red mite, no mite touched the castor seedlings.

(12) **The Stalks.**—Can be used for fibre-board manufacture or paper making, as they are high in cellulose.

(13) **The Leaves.**—Contain a substance which is toxic to insects, and can be used for the production of insecticides, but need planting near manufacturing centres as costs can be very high.

(14) **The Hulls** or castor cake, left over after hulling the fruit is not used for stock feed (because of the poisonous property Ricin and Ricinine), but for a fertiliser. It contains 4.5 per cent. N and is equal in fertiliser value to fresh barnyard manure.

In conclusion it may be pointed out that although the picture seems all bright, there is a need to develop a variety suitable for harvesting with the existing types of harvesters in use in Australia. There is also a need for a sufficient supply of seed to warrant oil extraction plants processing them. Also there is the point that both plants and seed are poisonous to stock, although it is reported that some cattle and fowls in Africa are unaffected when eating them, but normally stock do not touch castors.

KEEP YOUR JOURNALS

HERE at the production end, we are sparing neither expense nor effort in making the "Journal of Agriculture" a publication which will help you in your farming operations.

We suggest that the Journal is worth keeping and that a year's issue will make an attractive and useful volume for your library—a volume that is full of sound factual information, attractively presented.

Arrangements have been made for the compilation of a comprehensive index to be incorporated in the December issue—a feature which will greatly enhance the value of the Journal as a work of reference.

AUSTRALIAN TRACTOR TESTS

★

REPORT ON TEST No. 32
(Farmers' Edition)

FORDSON DEXTA

(Tested for Ford Motor Co. of Australia Pty. Ltd., Geelong, Victoria)



A Fordson Dexta at
Albany

THIS Report is taken from the full Technical Report No. 32 of this test: test results are shown here in briefer form: fuller explanations are added. Values quoted may be rounded out to two instead of three significant figures: to this extent the values may differ slightly but not significantly from those shown in the Technical Report. Graphs of belt test performance, shown in the Technical Report, are not shown here. The Technical Report is not available in large numbers, but it may be seen at, and copies of this farmers' report may be had from, the offices of the State Departments of Agriculture, the Bureau of Sugar Experiment Stations (Queensland), and the Commonwealth Department of Primary Industry.

1.—THE TESTS

(1) After twelve hours of running-in, two types of tests were carried out, in order to measure *the performance of the engine*, as measured by the power in the belt driven by the belt pulley, and *the performance of the tractor as a whole*, as measured by drawbar pull, tractor speed, wheel slip, and drawbar horse-power (d.b.h.p.), with the tractor running on a bitumen test track.

The main results of these tests are given in Sections 2, 3, and 4. Other measurements and observations were made of

various features of the tractor; these are given in Section 5.

In this Test No. 32, for the first time, tests were included on the engine removed from the tractor. All normal auxiliaries were fitted and functioning; power output (shaft horse-power, s.h.p.) was measured at the crankshaft. See Section 2.

(2) *Fuel Settings*.—The engine of this tractor has only one fuel setting, at which all the tests were carried out.

(3) *Governor Control*.—The engine was under the control of the governor set to give full fuel delivery, and so full power at rated engine speed.

The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement, the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne.

(4) *Fuel*.—Distillate, Diesel Index 54, Specific Gravity 0.84; weight per Imperial gallon 8.41 lb.

(5) *Specification*.—Engine No. 1416077. For a brief specification of this tractor see Section 6 at the end of this report.

2.—SUMMARY OF POWER OUTPUT

Table A

	At the Belt	At the Drawbar
Rated engine speed, r.p.m.	2,000	2,000
Maximum power (a)	30.0	26.9
Rated power (b)	26(b1)	20(b2)

Maximum shaft horse-power at 2,000 r.p.m. : 33.0.

Note.—Letters in brackets refer to explanatory foot-notes.

(a) No atmospheric corrections are applied to diesel engines because there is no suitable formula; the values shown above are, therefore, the observed maximum powers.

(b) Engines are not expected to run indefinitely at full or maximum power output. But they can be expected to run continuously for some hours at rated output, which is less than maximum, defined as follows:—

(b1) Rated b.h.p. is defined as 85 per cent. of corrected maximum b.h.p.;

(b2) Rated d.b.h.p. is defined as 75 per cent. of corrected maximum d.b.h.p.

3.—BELT TESTS

The belt tests show the power (belt horse-power, b.h.p.) that the tractor may be expected to deliver when driving a machine by the belt.

Table B—Belt Test Results

1. Rated engine speed, 2,000 r.p.m.	B.H.P.	Engine Speed	Fuel	
			Gall./hr. (c)	lb./b.h.p. (d)
2. Fast idling speed 2,200 r.p.m.				
3. Observed maximum b.h.p. at rated speed	30.0	2,000	1.75	0.49
4. Corrected maximum b.h.p. rated speed (a)	30.0	No correction made for diesel engines		
5. Calculated rated load (b1)	25½			
6. Test at approximately rated load	25.9	2,125	1.6	0.51
7. Average loading under governor (e)	17.1	2,140	1.2	0.61
8. Measured engine torque at full fuel delivery	87 ft. lb. at maximum power and rated speed			
	95 ft. lb. (maximum) at 1,300 r.p.m.			
9. Repeat of (3) above after 67 hours	No change			

(c) Fuel consumption in gallons/hour may be a simple unit, but it has no meaning unless we also quote the corresponding h.p. output.

(d) This is the "specific fuel consumption," the weight of fuel consumed per unit of energy developed by the engine; (the unit of energy here is the h.p.-hour, similar to the electrical "unit," the kilowatt-hour). When this figure is least the engine is giving its best economy or efficiency. It is easy to change from column (c) to column (d) in Table B, e.g., as follows:—

1.75 galls./hr. while developing 30.0 h.p. means 1.75 ÷ 30.0 galls./b.h.p./hr. = 0.058 gall./b.h.p./hr.
0.058 gall./b.h.p./hr. x 8.41 lb./gallon for this fuel = 0.49 lb./b.h.p./hr., as shown in column (d).

(e) Line 7, Table B, represents the average performance one might expect from the engine while driving a variety of belt loads, from light to heavy. In terms of average fuel consumption, it means about 1½ gallons an hour.

4.—DRAWBAR TESTS

(1) The following Tables C, D, and E, show the drawbar performance of the tractor, on the bitumen test track, wearing rear tyres 11 x 28, carrying maximum weight (1,500 lb. front 3,310 lb. rear; total, 4,810 lb.), working in the gears named in the tables. Height of drawbar 16 inches.

Drawbar tests, using standard weight of tractor (3,370 lb.), were carried out, but are not reported here.

Table C—Maximum Power, Rated (2nd) Gear

	DBHP (f)	Pull lb.	Speed m.p.h.	Wheel Slip % (g)
1. Rated engine speed, 2,000 r.p.m.				
2. Observed maximum d.b.h.p. at rated engine speed	26.9	2,850	3.54	9
3. Corrected maximum d.b.h.p. at rated engine speed (a)	26.9	No correction made for diesel engines		
4. Calculated rated load (b2)	20			

Table D—Pull at Maximum d.b.h.p.

All gears, rated engine speed. See note (h).

Gear	D.B.H.P.	Pull lb.	Speed m.p.h.	Wheel Slip %
1	16 (i)	3,700	1.6	18
2	27	2,850	3.5	9
3	28	2,200	4.7	6
4	28	1,725	6.0	5
5	28	1,000	10.4	3
6	Road gear not tested			

(f) D.B.H.P. is the product of pull (lb.) and speed (m.p.h.) divided by 375.

(g) Wheel slip can be measured by noting that, in travelling a given distance, the back wheels make more turns when working under load than when running with no load on the

drawbar. The difference in these revolution counts divided by the former count gives the slip as a ratio, which can be written as a percentage (quoted in these tables to the nearest whole number.)

(h) These are not the maximum pulls available in the gears (i.e., not the maximum sustained pulls), but the pulls at maximum d.b. power, i.e., at full-throttle at rated engine speed.

(i) Engine not fully loaded, maximum d.b.h.p. in first gear limited by wheel slip.

Table E—Fuel Consumption, Various Loads, Rated (2nd) Gear

Pull lb.	Speed m.p.h.	DBHP	Percentage of Maximum d.b.h.p.	Slip %	Fuel	
					Gall./hr.	lb./d.b.h.p. hr.
1,150	4.1	13	47	3	1.1	0.73
1,500	4.0	16	60	5	1.2	0.65
1,950	3.9	20†	75†	6	1.4	0.59
2,400	3.8	24	91	7	1.6	0.55

† Rated drawbar load.

(2) Interpretation of Drawbar Tests.

(i) Drawbar tests are carried out on a hard prepared surface. Most field conditions present higher resistance to the tractor's motion, so that, in the field, the maximum drawbar pulls available in any gear will usually be less than those shown in the tables.

(ii) Wheel slip may also be greater in the field; to that extent tractor speeds in miles per hour in the field will be less than those shown in the tables.

(iii) Because of (i) and (ii) above, the drawbar horse-powers available in any gear in the field will usually be less than those shown in the tables.

5.—OTHER OBSERVATIONS

(1) *Duration of Test.*—67 hours, including running in.

(2) *Repairs and Adjustments.*—None.

(3) *Engine*—

Fuel settings—one, fuel pump calibration checked in accordance with specification.

Heat controls—radiator and four-blade fan, thermostat.

Radiator water used—none.

Lubricating oil—S.A.E. 20.

Weight to engine, 14.0 lb.;

Weight from engine after test, 13.0 lb.

(4) Tractor Weights (lb.).

Weight condition	Front	Rear	Total
*Standard, unballasted	1,340	2,030	3,370
†Maximum weight, heaviest recommended	1,500	3,310	4,810
Includes—			
Water ballast (lb./wheel) ....	....	240	240
Solid ballast (lb./wheel)	75	400	475

* This weight, including driver and fuel, was used in finding centre of gravity.

Special Note on Light-weight Tractors.—This tractor is of the light-weight type designed for the operation of implements that are mounted on the three-point linkage, and controlled through the hydraulic system in such a way that some or all of the weight of the attached implement can be carried by the tractor, while the implement is at work. In this instance this is achieved by the Fordson Dexta "Qualitrol" unit.

A static test on the tractor in its standard, or light-weight, condition showed that the hydraulic system was capable of increasing the tractor weight to not less than the maximum test weight without lifting the front wheels off the ground and without overloading the rear tyres.

† Weight of tractor in drawbar tests quoted in this report.

(5) Wheels and Tyres.

Tyres		Front	Rear
Type	....	Rib	Open centre bar tread
Size	....	5.50 x 16, 4-ply	11 x 28, 6-ply
Pressure	....	20 psi.	12 psi.

(6) *Steering.*—With track widths, front 53", rear 53", wheel base 72":—

Turning circles: Without brakes, L.H. and R.H. 21'; with brakes, L.H. and R.H. 17'.

Comment: Easy to steer under load, sensitive to steering wheel; no power assistance.

(7) *Centre of Gravity,* with tractor in standard weight—2½" below, 29" forward of rear axle.

(8) *Driver's Accommodation.*—Access to seat, from either side forward of rear wheels. *Foot-room and support,* flat foot plates, foot rests, adequate. *Comfort,* deep plough-type seat with rubber cushion, adjustable fore and aft 2½". *Accessibility to controls,* clutch and brake pedals 20" apart, pedals approximately 14" below loaded seat. Clearance between clutch pedal and steering wheel makes operation of clutch awkward when employing the live-drive clutch.

Noise, sound pressure level measured 3 feet above loaded seat, in open field—
at full power rated speed—111 units.
at high idling speed—105 units.

The special unit is decibels of pressure compared with a base level of virtual silence. The levels quoted above are typical of tractors, which generally are noisy by accepted industrial standards.

(9) *Instruments*.—All clearly visible, markings adequate. Indications were consistent throughout tests. Engine tachometer is marked for standard p.t.o. and belt speed and for road speed in the gears.

(10) *Inspection of Engine and Transmission after Test*.—After testing, the tractor was partly dismantled and inspected and found to be in a satisfactory condition.

(11) *Instruction Books*.—Instructions for starting, running, and maintenance were satisfactory, and well illustrated.

6.—BRIEF SPECIFICATIONS

Fordson Dexta. (Based on Information Supplied by Manufacturers)

(1) *Engine*—No. 1416077.

4-stroke; 3 cylinders, vertical; crankshaft along tractor; diesel (indirect injection).

Bore, $3\frac{1}{2}$ " ; stroke, 5" ; compression ratio, 16.5 : 1.

Rated speeds: Belt and drawbar work, 2,000 r.p.m.

Fuel type: Distillate.

Fuel system: Simms 3-cyl. in-line pump, 2-hole spray type injectors. Two replaceable-element filters in series. Tank capacity, 7 gallons.

Air Cleaner: Oil bath.

Governor: Pneumatic, incorporated in fuel pump.

Electrical system: 12-volt battery and generator.

Starting: Electric; heater in manifold and fuel primer for cold starting.

Cooling: Water (pressure system), fan, pump, and thermostat.

Exhaust: Vertical, ahead of operator.

Fordson Dexta standard spark arrester fitted which conforms with S.A.E. Code. See Australian Spark Arrester. Test No. SPA-7.

Lubrication: Oil pump and full-flow filter, replaceable element type.

(2) *Chassis*—

4-wheel; pneumatic tyres.

Wheel base 72".

Track widths: Front 48" x 4" steps to 76", rear 48" x 4" steps to 76".

Tyre sizes: Front 5.50 x 16; rear 11 x 28.

Steering: Two-start worm drive.

Weight: Maximum, 4,810 lb.

(3) *Belt Pulley*—

Rear working, direction of rotation as required.

Diameter 9"; face width $6\frac{1}{2}$ ".

Speed (at rated engine speed), 1,290 r.p.m.

Belt speed (at rated engine speed), 3,040 ft./min., in accordance with overseas standards (namely, 3,100 $\pm$ 100 f.p.m.).

(4) *Power Take-Off*—

Centre rear; clockwise; guarded.

Speed: 690 r.p.m. at rated engine speed, not in accordance with overseas standards (namely, 536 $\pm$ 10 r.p.m.). At engine speed of 1,550 r.p.m., p.t.o. would be 536 r.p.m.

Dimensions: 6 spline, $1\frac{3}{8}$ " diameter.

(5) *Drawbar*—Linkage mounted drawbar. Height adjustable, 15"-26".

(6) *Transmission*—Conventional gears.

Clutch: Double dry plate, 9" diameter; second throw of pedal operates live drive.

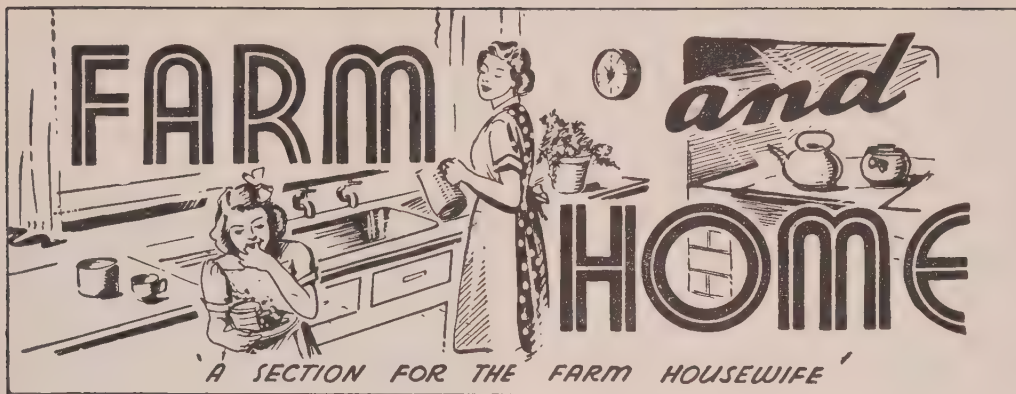
Gear ratios and road speeds (assuming no wheel slip) on 11 x 28 tyres, at rated engine speed, as advertised.

Gear	Forward						Reverse	
	1	2	3	4	5	6	L	H
Ratio	152.2	71.1	54.6	43.5	25.5	15.5	98.4	35.2
Speed, m.p.h.	1.8	3.8	5.0	6.3	10.7	17.5	2.8	7.7

(7) *Hydraulics*—Built-in, gear pump in rear transmission housing. Live drive.

(8) *Three-point Linkage*—Generally conforms to BS1841-1951, Category 1.

G. H. VASEY, Officer in Charge Tractor Testing.
W. F. BAILLIE, Tractor Testing Officer.
September 1959. University of Melbourne.



From Cropping to Crochet

By HELEN M. GLOSTER

MANY of our readers will now be enjoying well earned holidays at the sea-side, after a strenuous year on farms. The woman who is busily occupied all the year finds it difficult to sit for hours on the beach just watching the children paddling and playing with buckets and spades.

Crochet provides a pleasant, relaxing occupation, why not make a crochet bag? You could make one to go with that end of season summer frock you plan to buy.

The round bag illustrated was made in white knitting cotton, but could be made in coloured cotton which is available in a number of pastel shades.

The second bag, designed for a "teen-ager," was worked in white with sky blue zebra stripes..

sl. st. = slip stitch.

dc = double crochet.

THE ROUND BAG

Requirements.

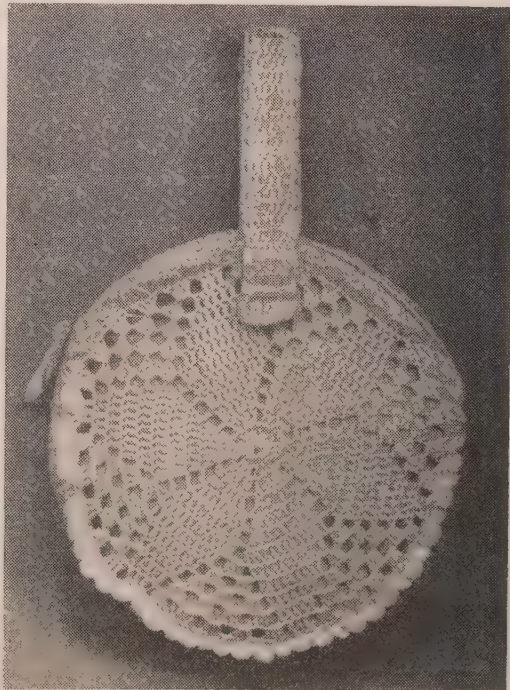
- 4 balls knitting cotton No. 4.
- $\frac{1}{2}$ yd. cotton lining material.
- $\frac{1}{2}$ yd. washable stiffening (book muslin).
- $\frac{1}{2}$ yd. $1\frac{1}{4}$ in. stiffening for handle.
- 2 buckles.
- 1 14 in. zip.
- Aero crochet hook No. 10.

Measurements.

- 12 inches across (approximately).

Abbreviations.

- ch. = chain.
- tr. = treble.
- beg. = beginning.



Directions.

Commence with 6 ch., join into a ring with sl. st.

First Round—

Three ch., (this stands for first treble) 2 tr., * 2 ch. 3 tr. into the ring; repeat from * 4 times, 2 ch. Join into the top of ch. at beginning of round with sl. st.

Second Round—

Three ch. 1 tr. into foot of ch., 1 tr. into next tr., 2 tr. into next; * 2 ch. 2 tr. into next tr., 1 tr. into next, 2 tr. into next tr.; repeat from * to end of round. Join into top of ch., at beg. of round with sl. st.

Continue working in this manner, increasing in first and last tr. of each tr. group, making 2 ch. between each group until there are 13 tr. in each group.

Next Round—

Miss * 1 tr.; 1 tr. into each next eleven trs., 2 ch., 3 tr. into space between, 2 ch.; repeat from * to end of round. Join into top of ch. at beg. of round with 1 sl. st.

Next Round—

Miss * 1 tr., 1 tr. into each of nine tr. 2 ch. 3 tr. into space, 2 ch.; miss 3 tr. group; 3 tr. into next space; 2 ch.; repeat from * to end of round. Join into top of ch. at beg. of round with 1 sl. st. Work three more rounds in this manner.

Next Round—

dc. into each stitch all round, end off. Make other side to correspond.

Gusset.

Note—

Work the zip section first. Commence with 8 ch., turn and make 1 tr. into 3rd ch. from work then 1 tr. into each remaining ch., 3 ch. turn.

Next Row—

1 tr. into each tr. 3 ch. turn.

Repeat this row until work measures 14 in. or the length of zip to be used. Work a second strip to correspond. Place two strips side by side and work 14 tr. across one end of two strips, 3 ch. turn. Repeat this row until work measures 35 in. or fits into circumference of the circles, end off. Join the ends with hand sewing and insert the zip into the slit before proceeding.

To Join Back and Front to Gusset—

* 1 dc. into first space, 4 tr. into next.

1 dc. into next * repeat to end of round, end with sl. st.

Handle.

Commence with 10 ch., make 1 tr. into 3rd ch. from end, 1 tr. into each remaining ch., 3 ch. turn.

Next Row—

1 tr. into each tr. 3 ch. turn. Repeat this row until work measures 18 in., end off with sl. st.

To Make Up Bag.

- (1) Cut lining to fit bag, allowing for turnings (2 circular pieces and a gusset strip). Make a 14 in. slit in centre of gusset strip for the zip.
- (2) Cut 2 rounds of interlining. There is no need to stiffen the gusset.
- (3) Place a round of stiffening against each round of lining, and machine lining to gusset.
- (4) Insert lining into bag and finish joining with hand sewing.
- (5) Line handle with stiffening, attach buckles, then sew on to bag.

Tab for Zipper.

Commence with 15 ch. Work 1 dc. into each ch. along each side with extra dc. at each end to turn corners. Work round once more in dc. end off. Sew tag to zip-pull.

FOR THE YOUNG MISS

Materials.

- 3 balls white knitting cotton No. 4.
- 1 ball blue knitting cotton No. 4.
- $\frac{1}{8}$ yd. cotton material for lining.
- 1 10 in. zip-fastener.
- 1 No. 10 Aero crochet hook.

Measurements.

11 in. x $7\frac{1}{2}$ in.

Abbreviations.

- ch. = chain.
- tr. = treble.
- sl. st. = slip stitch.
- dc. = double crochet.
- beg. = beginning.

First Row—

Commence with 65 ch. turn and make 1 tr. into third ch. from hook, then 1 tr. into each ch. to end of row, three ch. turn.

(These three ch. at beginning of each row make the first upright stitch.)



Second Row—

2 tr. into next two tr., 3 tr. into next tr., 3 tr. into next three tr., * miss 1 tr., 3 tr., into next three tr.—3 tr. into next tr., 3 tr. into next 3 tr. ** repeat to end of row, turn.

Third Row—

1 dc. into first tr., 3 ch., 2 tr. into next 2 tr., 3 tr. into next tr., 3 tr. into next 3 tr., * miss 2 tr., 3 tr. into next 3 tr., 3 tr. into next tr., 3 tr. into next three tr. * repeat * to *, to end of row, turn. Repeat the third row 16 times or until the work measures $7\frac{1}{2}$ in. Rows 5, 8, 14, 17, were worked in blue cotton.

Last Row—

1 dc. into first ch., 6 tr. into next 6 tr. * miss 2 tr. 7 tr. into next seven tr., ** repeat * to ** to end of row. End off. Make up the other side to correspond.

Gusset.

Commence with 11 ch., turn and make 1 tr. into 3rd ch. from hook, then 1 tr. into each ch. to end of row; 3 ch. turn.

Next Row—

1 tr. into each tr., 3 ch. turn. Repeat last row until work measures 26 inches and then end off.

Join bag to gusset with dc.

Handles.

Commence with 72 ch. Work one dc. into each ch., 2 dc. into end stitch then 1 dc. into each ch. down the other side.

Next Round

Change to blue cotton and work 1 dc. into each dc. down each side, working one or two extra stitches at each end to turn the corners.

Next Round—

Repeat last round in white and then end off. Make second handle to correspond.

To Make Up Bag.

Cut 2 pieces of lining $11\frac{1}{2}$ in. x 8 in. and a piece for gusset 27 in. x $2\frac{1}{2}$ in. Machine lining together. Handsew zip into position. Handsew lining into bag. Sew on handles $1\frac{1}{2}$ in. from ends.

Tab for Zipper.

Commence with 15 ch. Work 1 dc. into each ch. along each side with extra dc. at each end. Work 1 dc. into each dc. in blue and end off and sew on to zip-pull.



Honey Flora Calendar for March

COMPILED BY R. S. COLEMAN, APICULTURAL SECTION, WITH ASSISTANCE FROM THE BOTANICAL BRANCH

Common Name	Botanical Name	Where Found	Honey		Quality of Pollen	Remarks	Current Situation
			Quality	Quantity			
Hooked Mallee	<i>Eucalyptus uicinula</i> Turcz.	Mallee areas	Very little known in W.A. Victoria and South Australia regard it as excellent.	Good in South Australia and Victoria	Good in South Australia and Victoria	Not worked enough in W.A. to have any reliable reports	Should be flowering this year.
Blackbutt	<i>E. patens</i> Benth.	Found in place of Marri in some associations, Manjimup to Bindoon	Good	Good	Good	Buds and flowers same year. Collie and Balingup best stands	Not flowering this year, except perhaps in the Karri area.
Powderbark Wandoo	<i>E. accedens</i> W. V. Fitzg.	Occurs on the eastern side of main heavy rainfall areas mainly on the Ironstone ridges	Good, first quality	Heavy medium	Excellent	Powderbark can be differentiated from Wandoo, by the powdery bark and from the fact that in early winter the bark has a shagreened appearance. It is shed in the last week of January, and invariably sheds some mature buds just before flowering. This does not seem to lessen the crop of honey. Buds are held for three years, much the same as Wandoo	Some very small patches budded for 1961.
Red Morrel	<i>E. alessa</i> F. Muell. var. <i>longicornis</i> F. Muell.	Wheat belt area	Good	Uncertain but a few local reports said good yields obtained	Good	A tall tree on good soil, widely scattered and difficult to find enough trees to work as a flow. Could be tried when nothing else available. No information on buds.	No report.
White Gum or Wandoo	<i>E. redunca</i> Schau var. <i>elata</i> Benth.	Winter-flowering Wandoo; found from Chiltern North to Moorla	Excellent	Excellent	Excellent	Tends to be found in the valleys. Major honey plant	No budding report.
White Gum Mallee	<i>E. redunca</i> Schau	Summer Flowering	Good	Good	Poor	Found in Mallee areas	Not many reports but all have been good.

Karri	<i>E. diversicolor</i> F. Muell.	Donnelly Mills, Pemberton, Shannon Mill area	Choice	...	Heavy	...	Poor	Karri flowers in this area over 12 months but the major flow is mid-December, to the end of April. Flowering cycles are apparently related to changes in weather conditions, but attempts to induce growth and temperate weather in summer when the very small buds are present. Buds from growth of young tips to flower take three years	Should be in production in the Pemberton area, but might not be reliable.
Marri	<i>E. calophylla</i> R.Br.	Enneabba, south to east of Albany	Excellent	...	Excellent	...	Excellent	Major honey plant, very sensitive to climate	Patchy budding for 1961
Red Tingle	<i>E. Jacksonii</i> Maiden	Southern rainforest. Denmark	Excellent	...	Excellent	...	Excellent	Not big enough stands	No reports
Tuart	<i>E. gomphorephala</i> D.C.	Moore River-Busselton	Very good	...	Good	...	? Poor	Buds often eaten by borer. Seldom flowers	Could be flowering in Busselton-Manurah.
Sugar Gum	<i>Eucalyptus clatocalyz</i> F. Muell.	Not a native of W.A., but used as a street tree	Good	...	Heavy	...	Good	As this tree is planted extensively in some towns the local beekeepers get a good crop. Buds believed to be one year old at flowering	As this tree flowers every year, it should be investigated by beekeepers in areas where it is planted.
White Heath	<i>Leucopogon propinquus</i> R. Br.	Widespread	Good	...	Good	...	Good	Important when in dense stands	This should be good if we have rains in March.
Rottnest Tea Tree	<i>Melaleuca pubescens</i> Schau.	Rottnest, Cape Naturaliste and Dongara only	Poor	...	Good	...	Good	Only three stands known	Should be a good year.
Red Bell or Silky-leaved Bloodflower	<i>Calothamnus sanguinea</i> Labill.	Widespread, seems to like rocky slopes either lime or ironstone	Dark, good quality	...	Excellent	...	Good	Flowers over a long period	Look for the flow of this plant on the rock, gravelly outcrops on the edge of the Darling Range.

It will be seen from this list that information concerning many nectar-bearing plants is far from adequate. We would appreciate further information from beekeepers.

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PREPARATION OF VEGETABLES FOR MARKET

By J. P. FALLON, B.Sc. (Agric.),
Adviser, Vegetables

PROFITS in commercial vegetable growing depend as much on proper harvesting, handling and marketing as on good production practices. Many gardeners who are experts as producers are perhaps not so expert in presenting their produce in a manner which will command the most favourable return.

Harvesting and packing are the initial steps in distribution to the consumer. They present the first opportunity to impair or preserve the natural goodness of well grown vegetables. The arrival at the market and at consumers tables of vegetables showing minimum deterioration of appearance and of quality can be assured in large part by correct methods and management, before the produce leaves the grower's property.

Growers should keep in mind that fresh vegetables are living organisms. They undergo normal life processes. They lose water through transpiration, they respire and they undergo chemical changes. These processes contribute to gradual deterioration and are influenced by temperature, atmospheric humidity and other factors. All handling procedures should aim to retard these life processes without stopping them altogether.

The stages of development of vegetables when harvested is of utmost importance when managing perishable crops. For example, a single days delay in hot weather may result in serious deterioration of peas or lettuce. Frequent harvesting of tomatoes, melons, and beans or other vegetables which mature progressively is required to avoid losses through over maturity of some of the fruit.

Particularly important is care in the handling of perishable vegetables. Needless bruising or crushing in the course of harvesting and packing results in extensive damage and in addition is a principal contributory cause of decay.

Vegetables should be sorted. Uniformity in size, shape, colour and ripeness is of great importance in disposing of any product and this cannot be obtained without careful sorting and grading. In carrying out this grading work the grower should be guided to some extent by the view point of the housewife, who thinks in terms of individual specimens and their condition. To her, if she happens to obtain an unsatisfactory cabbage or cauliflower, it is of little consolation that 90 per cent. of the specimens in the particular pack marketed were desirable. If she is unfortunate enough to receive on a number of occasions overmature or undesirable vegetables, she may conclude that good quality vegetables of that type are unavailable. The family would be inclined to refuse second helpings and there would be no request for the same vegetable for the next meal or the next day. A number of experiences of this type can rapidly reduce subsequent purchases. Poor quality which results in slow sales and low prices is frequently associated with the development of glutted markets.

In packing vegetables for sale, the grower should aim to make each package as attractive as possible. This is achieved not only by cleaning and sorting and using proper containers, but by skilful arrangement. Appearance may sometimes be improved by the use of special lining papers for the containers. The use of attractive papers for packing has not received a great deal of attention by growers in this State, but is well worthy of consideration.

Honest packing is essential if satisfactory sales outlets are to be retained. This means uniformity of grade throughout a pack.

Fortunately, most vegetable growers in this State have only short distances to transport their produce to market. However, although the distance is short, care should still be exercised in giving proper protection to vegetables so that they do not deteriorate before reaching market. Many growers will be familiar with the browning of cauliflowers which can occur

by exposure of the curd to sunlight and wind even for short periods. Other vegetables are subject to similar forms of deterioration.

To sum up the prevention of marketing losses depends on vegetables being harvested at the right stage of maturity, properly graded, carefully packed in suitable containers and carefully handled at all times. If these points are kept in mind, many growers will effect a marked improvement in their product and their profits.



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CITRUS GROWING

IN THE HOME GARDEN

by

F. MELVILLE, B.Sc. (Agric.), Adviser, (Fruit) Horticultural Division

ALTHOUGH well suited to our climate, citrus trees do not always thrive in the metropolitan area because of the unsuitable soil conditions in some suburbs. Lemons can usually be grown successfully and grapefruit are worth persevering with, but oranges and mandarins are better suited to the loamy soils of the Gosnells, Guildford and Hills districts.

Lemon varieties which are commonly grown are the Eureka, a thornless, heavy bearing type, and the Lisbon, which has the disadvantage of being very thorny. In more recent times, the Meyer lemon has come on to the market, and is likely to be very useful in the home garden. Under our conditions, however, it does not bear summer crops.

There is not a great deal of choice of orange varieties but I would suggest planting Washington Navels or Valencias.

BUYING YOUNG TREES

There is a common fallacy that old trees and big trees will give better results and quicker fruiting. In practice, it is found that large trees receive a much bigger setback at transplanting, and often result from stunted trees which have been kept in the nursery until they have made reasonable growth. It is far better to obtain vigorous young trees, that is trees that are one year old from the bud, and are in no way stunted. Nursery trees can be obtained either with balled roots or with bare roots, in which case they are usually packed in sawdust.

Provided the trees are planted soon after lifting, it is immaterial which method is used, but balled trees would be better able to withstand adverse handling conditions.

If the roots are packed in sawdust, this should be completely removed before planting. On no account should the root system of a young citrus tree be allowed to dry out.

PLANTING SITE

Consider such factors as competition from established trees, lawns, etc., protection from strong winds, particularly near the coast, and also choose a sunny aspect.



Orange trees are difficult subjects in the metropolitan sands owing to heavy fruit shedding. In loamy soils they are well worth while cultivating

PREPARATION OF PLANTING HOLE

Much of the success with citrus trees depends on the initial start the young

trees receive. Time spent in preparing the soil before planting will amply repay the effort.

A hole 2 ft. 6 in. deep and 4 ft. in diameter is suggested, although often trees are planted with far less preparation. Apply a dressing of about 3 lb. of mixed fertiliser, for example potato manure, in the bottom of the hole, and add copious quantities of organic matter such as farm-yard manure, poultry manure, compost, blood and bone, etc. Intersperse this with layers of soil. Loam may be added if desired, but should be well mixed with the rest of the soil.

PLANTING

Trees are usually available from the nursery by the beginning of July, and should be planted as early as possible. Soak the trees in water as soon as received, and before planting trim off any damaged roots. In the case of a balled tree, do not disturb the ball, but after planting carefully cut the string to release the hessian binding, and fill in the top soil. Make sure the tree is planted in clean soil, free from added organic matter or artificial fertilisers. Keep the bud union well above the ground level to allow for subsidence as the organic matter in the hole rots away. If the bud union is covered, there is a strong possibility of collar rot developing at a later stage.

Firm the soil around the roots, and water immediately. Prune the top to balance the loss of roots. Cut back hard to three well-placed branches of say 6 to 8 in. long. Do not be afraid to remove the major part of the foliage, as failure to do so is a common cause of heavy leaf drop, and poor development.

CARE OF THE YOUNG TREES

The trunk of the young tree should be protected from the sun by wrapping with newspaper, corrugated cardboard, etc., tied loosely top and bottom. Alternatively, a light shelter of hessian, etc., can be used with good effect for the first few months.

Apply a soil mulch of grass around the tree to reduce soil temperatures and moisture loss, and ensure that the tree is never short of water. Apply sufficient water to wet the soil to a depth of 15 to 18 in. to induce the roots to penetrate into the deeper layers. The roots will not grow

into dry soil, and frequent surface watering can induce very shallow root systems.

During the first summer, dressings of sulphate of ammonia at the rate of 2 or 3 oz. every six or eight weeks should be given at the time of watering. This will induce satisfactory growth in the young tree, which is essential if it is to come into bearing at an early age. Size of the tree rather than age will determine its bearing capacity.

CARE OF THE ESTABLISHED TREE

Manuring.

The mistake is often made of going to great pains to prepare the soil prior to planting the tree, but failing to maintain adequate supplements in later years. This results in the tree developing under artificial conditions and at the time when it should be coming into bearing it is being subjected to a declining plane of nutrition. This will restrict the growth of the tree and upset its bearing habits.

A suitable fertiliser programme for the poor metropolitan sands would be as follows:—

Apply a dressing of up to 5 lb. of mixed fertiliser for a large tree during the winter months. Use ample quantities of any type of organic material to build up the organic matter content of the soil. Compost, animal manure, poultry manure, etc., can be used with the object of moisture retention, encouraging earthworms, and other beneficial soil organisms, and also reducing the soil temperature.

In the spring and summer months, apply light dressings of sulphate of ammonia or alternatively fowl manure. Citrus trees have a high nitrogen requirement, and will not prove successful unless this need is met. Trace element deficiencies will probably occur, and the following spray will prove useful if deficiency symptoms are noticed.

Copper Oxychloride	....	1½ oz.
Zinc Oxide	....	2 oz.
Manganese sulphate	....	6 oz.
Water	....	4 gall.

Spring application is best, but the spray can be used whenever the tree is making new growth.

Cultivation.

Do not dig deeply around citrus trees. Hoe or pull out weeds to reduce competi-

tion, but apart from this do not disturb the soil more than can be helped.



Grapefruit grow well in the Perth climate even under sandy conditions but they are very subject to fruit fly

Watering.

The aim of successful irrigation is to wet the whole root zone of the tree. Any further water will be wasted. The lateral spread of water in sand is poor, and therefore uniform distribution over the full extent of the root perimeter is necessary. Putting a hose to run under the tree may only result in the water quickly soaking into the ground and penetrating below the root zone without affecting the main lateral roots. Overwatering can be detrimental by washing soluble nutrients from the soil.

Pruning.

Citrus trees do not need extensive or annual pruning. Lateral shoots developing on the trunk of young trees should be completely removed. Strong shoots coming from the main head of the tree should be shortened back to induce the growth of lateral shoots and so prevent the tree becoming unbalanced. Old trees which are declining can be thinned out, removing spent and dead wood, and this applies particularly to lemons, which benefit from a periodical cutting back. It must be always remembered that pruning alone will not rehabilitate a declining tree. Nutritional aspects and pests and diseases must also be taken into account.

PESTS AND DISEASES

The main pests with which citrus trees are infested are the various types of scales,

i.e., red, brown, white wax and cottony cushion scale. In addition, aphids, citrus white fly and fruit fly, can cause considerable damage.

The fungus diseases attacking citrus trees are collar rot, which causes girdling of the trunk, and brown rot, which attacks leaves and fruit causing excessive defoliation.

A suitable spray programme for citrus trees would be as follows:—

During late December and January, spray with 1 in 40 white oil at least twice to control scale insects. It is essential to use spraying equipment which will thoroughly drench the tree. An average size citrus tree will take up to four gallons.

In April, before the winter rains, apply a spray of Copper Oxychloride according to the maker's recommendations.

In October, use 1 in 40 white oil plus 1 in 600 nicotine sulphate for white fly and aphids, and make later applications where aphids are bad.

Foliage baiting for fruit fly should be carried out while ripe fruit is on the trees, and also during odd times when other trees in the vicinity are being baited.

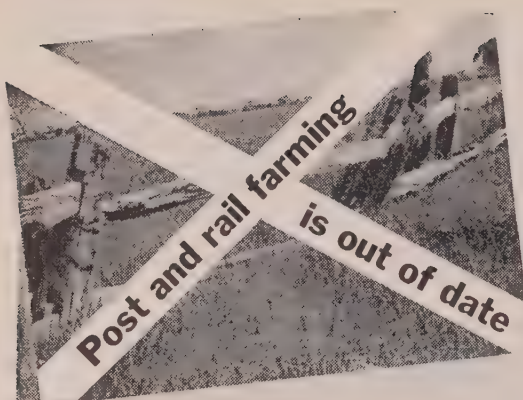
PHYSIOLOGICAL DISORDERS

Considerable damage is done to citrus fruits by unfavourable weather conditions. Excessive heat will cause heavy shedding of young fruits, and in the case of lemons will bring about sunburning and internal decline of the fruit. When an affected lemon is cut open, it will be found that one side of the fruit is normal, whereas on the other the pulp is brown and often dried up.

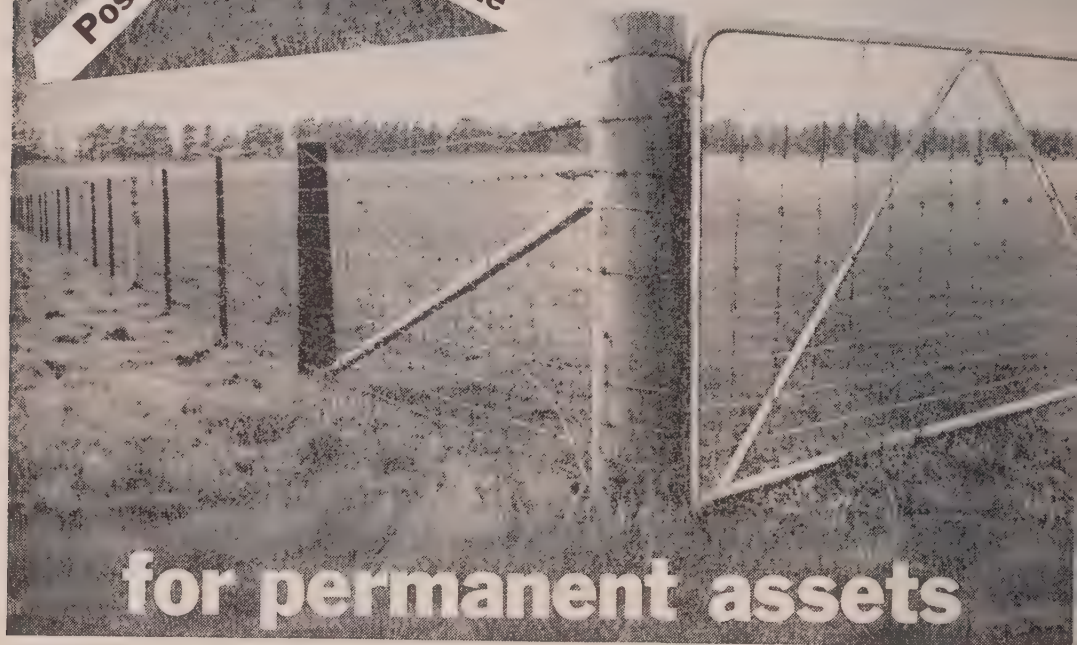
Fruit drop may be minimised by good growing conditions, adequate watering and in some instances by the use of soil dressings of bluestone. Care is necessary however, to ensure that only light applications of 3 to 4 oz. of bluestone are made at any one time because of the danger of root damage.

VEGETABLES AMONG FRUIT TREES

Provided the requirements of the trees are met, there is no reason why other garden subjects may not be grown among them. In fact, trees often get much better attention, under these conditions, than they would otherwise. However, avoid planting too close to the trees, and do not dig deeply in close proximity to them.



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MINOR ELEMENTS

CAN BE OVERDONE

By L. T. JONES, B.Sc. (Agric.), Plant Research Division

THE term "minor elements" which is now commonly used and well understood by farmers and gardeners, refers to the five essential plant foods—copper, zinc, manganese, molybdenum and boron. These five essential plant foods are needed by all plants in minute quantities and it is relatively easy to use them in excess of actual requirements or even in toxic amounts. In practice this is not usually a problem with cereals and pastures. The important exception is when zinc alone is added to a cereal crop low in copper and the extra zinc accentuates the copper deficiency, and poorer yields are obtained.

With citrus trees, copper deficiency is often controlled by the use of a soil dressing of bluestone or copper sulphate at the rate of 1-4 lb. per tree depending on the size of the tree. For safety this material is normally placed in a circular furrow about 3 feet out from the trunk of the tree. If this quantity of bluestone is broadcast uniformly up to the trunk of the tree, it may severely injure the root system so that the tree either dies or quickly sheds its leaves.

Most of the local cases of minor element toxicity have been met with in market gardens but the principles involved apply equally as well to home gardens and the recommendations discussed will refer specifically to these two fields. It is usual to recommend a copper application of about 10 lb. per acre of bluestone as adequate and safe. The copper containing fungicides—Bordeaux spray and Copper oxychloride also supply copper to the plant. Zinc may be applied as zinc oxide at 3-5 lb. per acre or as zinc sulphate at 5-10 lb. per acre. The zinc containing fungicides such as Ziram and Zineb also supply zinc to the plant. It is recommended to apply 10-20 lb. of manganese sulphate per acre for row placement and up to 56 lb. per acre if broadcast. A more popular method is to use a 1 per cent. manganese sulphate

foliage spray. Although manganese deficiency is prevalent in market gardens, manganese excess is also a very common problem as the result of the unwarranted heavy applications of manganese sulphate. It is quite common in garden crops, and especially in tomatoes, to see a characteristic yellow leaf symptom which in many cases has been induced by toxic levels of copper, zinc or manganese either singly or combined.

Sodium molybdate at 2 lb. per acre is one method of controlling molybdenum deficiency in the very susceptible crops such as cauliflower, rockmelons and cucumbers. In the seedbed, 3 oz. of sodium molybdate to 10 square yards of bed is used and this is sufficient for their complete life. A foliage spray of 1 oz. or less of sodium molybdate to 4 gallons of water may also be used, if applied when the plants are reasonably young.

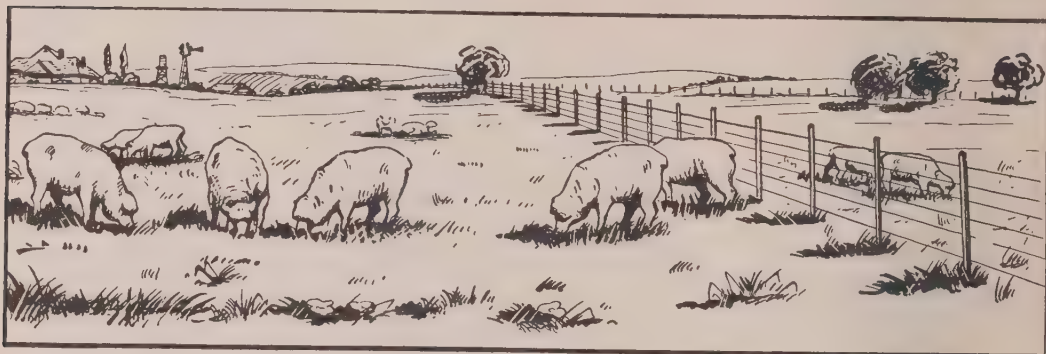
For the control of boron deficiency, it is usually recommended to apply borax at the rate of 10-20 lb. per acre, as higher rates may be toxic.

It has been found from local experience that the minor elements can be safely applied at the rates previously quoted and furthermore, annual applications at these rates do not appear as yet to have built up to toxic levels. It is also evident that

minor elements are being applied in a large number of cases as a form of insurance against the occurrence of possible soil deficiencies which in actual fact are not operating.

And finally, don't use minor element mixtures just because it is fashionable.

Satisfy yourself firstly that there is a genuine need for their use, then apply them when necessary at the correct and safe quantities. Always remember that you are dealing with nutrients which quickly become poisons when used at excessive doses.



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PLANT DISEASES

CONTROL OF DAMPING-OFF IN SEED BEDS

By the Plant Pathology Branch

"DAMPING-OFF" of seedlings is caused by a number of moulds, for example *Pythium*, *Rhizoctonia*, etc., which are common inhabitants of garden soils.

Under certain conditions of temperature and moisture, these moulds may attack the germinating seed or young seedling causing it to rot either;

- (1) before it appears above the soil surface—"pre-emergence damping-off" or;
- (2) after it has emerged causing a rotting of the stem at ground level with subsequent collapse of the top (see Fig. 1)—"post-emergence damping-off."

Damping-off organisms become prevalent in soils which are frequently used for raising seedlings. Hence it is desirable to use new soil each time a seed bed is prepared. If this is impracticable, appropriate control measures should be applied as losses from damping-off are unpredictable and often very serious.

SEED TREATMENT

Frequently adequate control of pre-emergence damping-off can be obtained by treating the seed prior to planting with a fungicidal dust such as Chloronil (e.g., Tetroc or Coversan) organic mercury (e.g.,

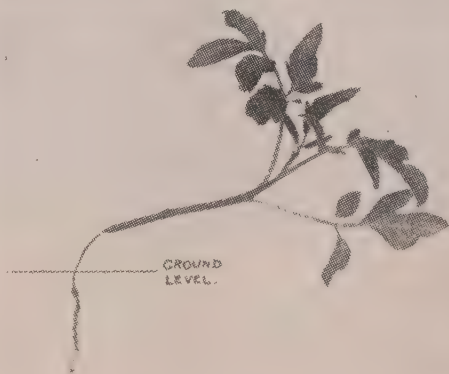


Fig 1.—Seedling attacked by damping-off fungus, showing the constriction of the stem at ground level (After Geoffrey Samuel. J.S. Aust. Vol. 34, p. 371.)

Ceresan, Agrosan, etc.), Captan, Copper Carbonate and Thiram (see Figs. 2 and 3). Care should be taken in selecting a suitable dust—for example, Chloronil is excellent on peas and beans but is damaging to tomatoes. Before use, carefully check the maker's recommendations to ensure that the dust being used is suitable for the particular seed. Further details on specific

seed treatments for vegetables is available in Leaflet No. 1044.

Seed dusts are best applied by placing both the seed and the required amount of dust in a large screw capped jar and shaking for two to three minutes until all the seeds are coated. Any surplus dust may then be sieved off. The coating of fungicide has the effect of partially sterilising the soil in the immediate vicinity of the seed, thereby promoting better emergence.

SOIL DISINFECTION TREATMENTS

A number of chemicals are available for disinfecting soil before planting. Some will be effective against all soil organisms and weed seeds, others are selective in their action. In all cases the soil should be

with the Formalin solution for at least two days. During the next fortnight dig the soil over thoroughly several times to allow the fumes to escape before planting.

2. Chloropicrin (Tear Gas).—This is very satisfactory against fungi bacteria and eelworms, but it gives off an irritant and highly toxic gas which necessitates the use of protective equipment including gloves and gas mask. Do not use Chloropicrin if the temperature is below 60° F.

Method of Application.—Inject $\frac{1}{2}$ a teaspoon of Chloropicrin at 9 in. centres and 6 in. deep. Firm the soil down immediately and water the area well or cover it with a gas proof covering. After one week cultivate to allow the fumes to escape before planting. Planting may be carried out

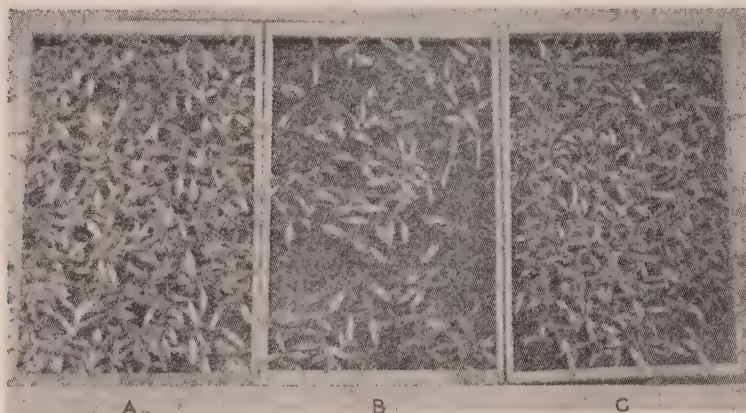


Fig. 2.—Pre-emergence damping-off of tomato seedlings controlled by seed protectant dressings. A—Seed dusted with Ceresan. B—Untreated seed. C—Seed dusted with red cuprous oxide

(After Chamberlain and Brien. N.Z.D.S.I.R. Plan. Dis. Div., Bul. 1.)

cultivated, manured and watered to good seed bed condition before treatment is applied. The most useful and widely used materials are:

1. Formalin.—This is one of the best soil fungicides but is less lethal to insects and eelworms.

Method of Application.—Mix one part of commercial Formalin with 49 parts of water and drench the soil at the rate of $\frac{1}{2}$ -1 $\frac{1}{2}$ gallons per square foot depending on the soil type. The heavier soils require the higher dosage rate but sufficient must be used to saturate the soil. Cover with bags or thick paper and keep the cover wet

when the fumes are no longer noticeable, usually about one week later.

3. Methyl bromide.—Methyl bromide has the advantage of being effective against eelworms and most weed seeds in addition to the soil fungi and bacteria. This material which is a gas at ordinary temperatures is marketed in sealed containers and requires special apparatus for application to the soil. As for Chloropicrin, it must be handled with extreme care as it is highly lethal to humans. Methyl bromide gas is completely odourless and therefore some manufacturers include a small amount of Chloropicrin so that the presence of the gas can be recognised.

Most firms distributing the material provide a specialist operator service at small cost. Methyl bromide is used by releasing one to two pounds of the material per 100 square feet of soil surface under a gas proof sheet. The sheet is supported above the soil in the centre but buried in the soil at its edges to prevent leakage. Gas

fungicide drenches. These drenches should be applied at the first sign of post-emergence damping-off. Various organic fungicides can be used for this purpose including Thiram, Captan or Zineb. One ounce of the selected material is mixed with four gallons of water and applied at the rate of $\frac{1}{2}$ -1 gallon per square yard. It

Fig. 3.—The value of spinach seed treatment is well illustrated by comparison of the stand in the nine cuprous oxide treated rows on the left with that in the five untreated rows on the right. (After N.Y. (Cornell), Agri. Exp. Sta., Bul. 566.)



proof plastic sheeting is suitable for application but some growers prefer specially made and more durable corrugated iron covers. The cover can be removed after one to two days and the soil raked to form the bed. Planting can be done within 24 hours. No special digging over is necessary.

4. Heat Treatment.—The most effective heat treatment involves the use of steam generated in a boiler and injected through tubular spiked harrows. However, the high cost of equipment and operation precludes its widespread use. Partial disinfection can be achieved by burning rubbish, etc., on the surface of the soil, but heat penetration is not very great unless a large fire is used. This can damage the soil by destroying humus.

FUNGICIDE DRENCHES

When seed and soil disinfection treatments have been neglected and post-emergence damping-off develops, losses can often be reduced by the application of

may be necessary to repeat the treatment two or three times to get adequate control. Another older remedy which can prove useful is *Cheshunt compound*. This material is prepared as follows:—

- (1) Crush separately two ounces of bluestone and eleven ounces of rock ammonia (ammonium carbonate) to a fine powder (it is essential that these materials be fresh.)
- (2) Mix thoroughly and store for 24 hours (at least) in a tightly closed glass or stone jar.

To Use.—Dissolve 1 ounce of the mixture in a little hot water and make up to two gallons with cold water. The solution will attack vessels of iron and tin and therefore should only be placed in them immediately before use. Use one quart for each square yard of seed bed. Immediately after treatment water the plants to remove any of the chemical lodged on the leaves. (Subsequent treatments may be necessary twice a week.)

COVER SPRAYING FOR THE CONTROL OF CELERY LEAF SPOT — II

By S. C. CHAMBERS, M.Sc., Plant Pathologist

SEVERAL additional cover spray schedules for the control of leaf spot in winter celery, have been evaluated during the past two years. The most satisfactory of these is one in which Bordeaux 4 : 4 : 40 is replaced by Ziram for the last two applications before harvest.

Celery Leaf Spot, caused by the fungus *Septoria apii* Chester, has been a serious problem (affecting both yield and quality) in winter grown celery for many years. Although it can be controlled with Bordeaux 4 : 4 : 40 (Chambers, 1958), this fungicidal material discolours the foliage of celery and thus detracts from the market value of the produce.

In an endeavour to overcome this problem, further field experiments have been conducted, using schedules in which Bordeaux was replaced by non-discoloring sprays as the crop approached maturity. In the same trials, the efficacy of several other copper fungicides was compared with that of Bordeaux mixture.

EXPERIMENTAL

The field work was carried out on the property of Mr. W. Stevens, Balcatta during the winters of 1959 and 1960. In each season, portion of the celery crop was divided into a randomised plot system and the selected fungicidal treatments were applied to the appropriate plots.

The incidence of Leaf Spot in relation to treatment was assessed just before harvesting. In order to do this, randomised samples of 100 leaves from each plot were examined, and a numerical value was

allotted to the condition of each leaf in accordance with Table 1.

The mean value obtained for each plot was transformed to an $\sqrt{x}$ value during the analysis of results.

1959 SEASON

This trial consisted of a simple randomised system of plots, each measuring 21 links in length by 2 rows in width. It was designed to incorporate 5 replications of the following eight simple and split schedules:—

Simple Schedules (fungicide applied at intervals of 10 days)—

- (1) Bordeaux 4 : 4 : 40.
- (2) Colloidal Copper $2\frac{1}{2}$ pints/100 gal.
- (3) Copper oxychloride 4 lb./100 gal.
- (4) Copper zinc chromate 2 lb./100 gal.

Split Schedules (fungicide applied at intervals of 10 days)—

Each of these 4 schedules was commenced with Bordeaux 4 : 4 : 40.

For the last 3 applications before harvest, this was replaced by one of the following:—

- (5) Ziram $1\frac{1}{2}$ lb./100 gal.
- (6) Colloidal Copper $2\frac{1}{2}$ pints/100 gal.
- (7) Copper oxychloride 4 lb./100 gal.
- (8) Copper zinc chromate 2 lb./100 gal.

Spraying was begun on April 20, 1959, and continued until August 3, 1960. The incidence of leaf spot in relation to treatment was assessed on August 10, 1960, and an analysis of these results is contained in Table 2.

Table 1
CLASSIFICATION OF LEAF SPOT SYMPTOMS
ON INDIVIDUAL LEAVES

Class	Symptoms on Leaf	Numerical Evaluation
1	No visible symptoms	0
2	Less than 4 lesions per leaflet	1
3	More than 4 lesions per leaflet	2
4	Coalescence of lesions causing: (a) Partial or complete collapse of 1 leaflet	3
5	(b) Partial or complete collapse of more than 1 leaflet	4

Table 2
EFFECT OF VARIOUS SCHEDULES ON THE
INCIDENCE OF LEAF SPOT IN 1959

Schedule	Evaluation of disease incidence	
	Mean leaf value	Data transformed ($\sqrt{x}$)
Bordeaux followed by Ziram	0.29	0.541
Bordeaux followed by Copper oxychloride	0.42	0.645
Bordeaux	0.43	0.658
Bordeaux followed by Colloidal copper	0.48	0.690
Bordeaux followed by Copper zinc chromate	0.49	0.697
Copper oxychloride	0.69	0.833
Colloidal copper	1.45	1.205
Copper zinc chromate	2.23	1.494
Difference for significance $P = 0.05$ .....	....	0.290

1960 SEASON

In view of the previous year's results, it was decided to eliminate those schedules involving the inferior sprays of colloidal copper and copper zinc chromate. In addition, the time interval between applications was increased from 10 days, to 14 days, so as to accentuate any differences between the relative efficacy of the remaining fungicides.

Consequently the trial was restricted to the following four modified simple and split schedules.

Simple Schedules (fungicide applied at intervals of 14 days)—

- (1) Bordeaux 4 : 4 : 40.
- (2) Copper oxychloride 4 lb./100 gal.

Split Schedules (fungicide applied at intervals of 14 days) —

Each of these 2 schedules was commenced with Bordeaux 4 : 4 : 40.

For the last 2 applications before harvest, this was replaced by one of the following:—

- (3) Ziram $1\frac{1}{2}$ lb./gal.
- (4) Copper oxychloride 4 lb./100 gal.

The experimental plot design was in the form of 2 adjacent latin squares and contained 8 replications of the 4 treatments. Each of the 32 component plots measured 25 links in length by 2 rows in width.

Spraying was commenced on May 2, 1960, and continued until September 5, 1960. The incidence of leaf spot was assessed on September 14, 1960, and an analysis of results is contained in Table 3.

Table 3
EFFECT OF VARIOUS SCHEDULES ON THE
INCIDENCE OF LEAF SPOT IN 1960

Schedule	Evaluation of Leaf Spot Incidence	
	Mean leaf value	Data transformed ($\sqrt{x}$)
Bordeaux	0.63	0.794
Bordeaux followed by Ziram	0.74	0.859
Bordeaux followed by Copper oxychloride	0.90	0.947
Copper oxychloride	1.72	1.312
Difference for significance $P = 0.05$ .....	....	0.082

From these results it is evident that the most satisfactory of the four schedules was the one in which Ziram replaced Bordeaux for the last two applications. It was significantly better than those containing copper oxychloride, and it also largely overcame the discoloration problem of Bordeaux, without increasing the incidence of Septoria Leaf Spot.

RECOMMENDATION

Septoria leaf spot can be effectively controlled in winter grown celery by spraying with Bordeaux 4 : 4 : 40. The first application should be made a week after transplanting and subsequent sprays should be applied regularly, at intervals not exceeding 14 days. To overcome the discoloration problem of Bordeaux, this fungicide should be replaced by Ziram ($1\frac{1}{2}$ lb./ 100 gal.) for the last 2 applications before harvest.

ACKNOWLEDGMENTS

The author is indebted to Mr. W. Stevens, Balcatta, on whose property the trial was conducted. Thanks are due also to Mr. W. Pickering for his assistance with the field work.

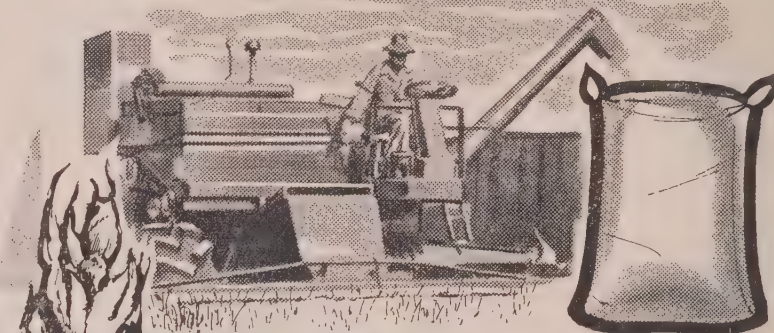
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HEALTHY PASTURES

By F. E. RYAN, B.Sc. (Agric.), Agrostologist

IN sweeping away forests to make room for pastures we have taken on the responsibility of maintaining these areas in a condition suitable for the growth of pasture plants. This is done by a choice of suitable species, fertilising, cultivating, drainage, control of grazing and by weed and insect control.

Now let us consider some of the moisture relationships of pasture plants in the higher rainfall areas.

The very sandy soils of the west and south coast have a very poor capacity to hold moisture. They can grow only short-lived or deep rooting pasture species. *Serradella*, which is relatively deep rooted, is more successful on sandy rises than sub clover in some cases during the first few years. When organic matter in the soils increases the soils hold more moisture and sub clover and better pasture species can be carried. Earlier varieties of subterranean clover, such as, *Dwalganup* or *Yarloop* have been successfully established on dry banks. A mistake frequently made is total clearing of she-oak-banksia rises, as this surface cover prevents excessive evaporation from the surface. Feeding of hay on such areas increases the organic matter in the surface soil and assists in later establishment of pasture. Where kikuyu has been successfully established on sandy soils it has been successful in providing a cover on the surface of the soil to retain moisture and at the same time increase the organic matter in the soil as its old roots rot away.

Other areas receive too much water. This prevents root growth during the winter months and causes pastures to stagnate at this time. With a very shallow rooting system plants are unable to feed and their growing period is greatly shortened. Weak and unhealthy plants are very susceptible to attacks by diseases and insects. Drainage is necessary to overcome these conditions, encouraging root growth during the winter months and encouraging winter

growth of leaves. Spring growth will be more vigorous and what is even more important the plants will continue to grow for a longer time in the spring because of their deeper rooting system. Root growth in many plants is most active during the winter and early spring months whereas leaf active growth comes later. A common sight on some winter wet pasture paddocks is the late spring and summer growth of stinkwort. Essentially this plant is using up reserves of soil moisture which were not used by the pasture plant in spring because of its too shallow rooting system. Stinkwort makes later growth and its roots have the opportunity of developing as the water table recedes.

Where drainage is very difficult because of the lack of a suitable outlet for drainage water or the nature of the soil, plants with ability to succeed reasonably well under these conditions should be planted. These include such legumes as *Yarloop* subterranean clover, *Tallarook* subterranean clover, *Lotus major*, *Strawberry* clover and white clover and grasses such as kikuyu, *Water couch*, *Paspalum* and *Phalaris arundinacea* and ordinary couch. Lucerne should never be planted under waterlogged or winter wet conditions.

An unusual moisture relationship occurs in some of our soils in that they are difficult to wet when dry. This occurs in the sandy soils along the west coast and may cause a good deal of trouble in establishing subterranean clover. This condition is overcome by deep seeding and on these sandy soils sowing of subterranean clover to a depth of 2 inches has been successfully employed.

On the fibrous acid peaty sand soils which occur along the south and west coasts the soils may only become moist enough for germination as they flood from below. Even after 6 inches of rain had fallen in 7 days the soils may be dry in the top 4 inches though there is a permanent water table at about 5 inches below the surface. The removal of the fibrous material by burning and the mellowing of the soil by the growth of softer roots in it helps to improve its physical condition.

The lack of water may induce deficiency diseases in plants in some instances and a good example is manganese deficiency in oats which becomes obvious during a dry spell. Another deficiency which is related to water supply in some cases is potassium. This is very marked in winter waterlogged flats where a very shallow rooting system is developed. In the spring the very shallow and restricted root system is unable to obtain sufficient potash to supply the heavy requirements of the

plants. The same position is very common in our irrigation areas. Waterlogging during the winter months has prevented bacterial action and organic matter accumulates in the surface of the soil. Plant roots are unable to penetrate this organic layer and the very short roots are unable to obtain the large amounts of nutrients required for vigorous growth. Pastures become unhealthy and show signs of potash and other deficiency symptoms.

Root growth and nutrient uptake from soils is greatest when the soil is wet to field capacity, that is, when there is a reasonable film of water around each particle of soil but between the particles there are air spaces enabling roots to breath. Where this condition prevails through a good depth of soil roots penetrate deeply, branch freely and can absorb very much greater supplies of nutrients for pasture growth. Pasture plants may die of thirst or be drowned. It is our responsibility to prevent this.



A NEW TOMATO

An excellent crop of a new hybrid tomato variety bred by the Department of Agriculture was recently inspected by the Minister for Agriculture (Mr. C. D. Nalder), who said that the plants were remarkably vigorous, very free of spotted wilt and were producing heavy yields of good quality round fruit.

The new hybrid is being tested commercially by Mr. L. Buktenica, an Osborne Park market gardener, who is growing more than 4,000 plants of this variety, and the fruit because of its attractive appearance and good keeping qualities has realised a much better average price than the standard "Early Crinkly" tomato variety grown under similar conditions.

The new hybrid has been evolved by the Government Plant Pathologist, Mr. W. P. Cass Smith and Plant Pathologist, Olga M. Goss, after trials extending over 10 years with the object of developing a disease resistant tomato that is round fruited and early maturing and which can satisfactorily replace the local "Early Crinkly" variety which has poor fruit characteristics.

It is anticipated that seed selected from superior plants of this year's crop will be bulked in 1961 and available to commercial growers for planting in 1962.

A Grazing Management Trial for the Control of Lupinosis in Sheep

By H. G. NEIL, B.Sc. (Agric.), C. M. RALPH, B.Sc. (Agric.), and A. W. HOGSTROM, B.Sc. (Agric.), Advisers, Wheat and Sheep Division

A "WASTING" disease of sheep grazing on lupin stands, usually accompanied by heavy mortality, has become a serious problem in coastal areas between Perth and Geraldton in the past ten years.

Dry stands of West Australian blue lupin (*Lupinus digitatus* Forsk)* are used extensively in the Dandaragan and Gingin districts for grazing sheep during the summer months. This lupin is also used as a pioneer species in the development of light land in the country west of the Midland Railway.

Since 1950 the area sown to lupins in the Dandaragan area has increased by some 50,000 acres while along the coastal belt large tracts of light land have been sown to lupins. The increased area of lupins and the consequent changes in pasture management have contributed to the incidence of the disease which has caused losses of up to nearly 80 per cent. in some individual flocks.

The disease "lupinosis" was described by Bennetts (1) who has reported that it occurs on pastures carrying the W.A. blue lupin and the N.Z. blue lupin (*L. angustifolius* Linn).

A survey of the Dandaragan district conducted by the Department of Agriculture in 1959 (Neil et al (2)) showed that lupinosis occurs where sheep are compelled to eat mainly lupin roughage. Indications were that any practice which tended to reduce the intake of lupin roughage would reduce the incidence of the disease.

* Previously referred to as *Lupinus varius*.

INVESTIGATION AT CREIGHTON PARK

In order to test the effect of diet on the control of lupinosis a trial was started at

Dandaragan on V. and K. Williams property, "Creighton Park," in January, 1960. The site of the experiment was a paddock in which sheep had developed lupinosis in the previous month as well as in other seasons.

This paddock carried a six year old lupin stand on second class marri (red gum) country. It had been grazed continuously since the 1957/58 summer, with the result that there was very little feed other than a dense stand of lupins which, under normal grazing could be expected to fatten sheep at the stocking rate used. An area of 20 acres with a uniform cover of lupins was divided into four paddocks, each with its own water supply.



The sheep on the left did not have any hay supplement while the sheep on the right received a supplement of hay throughout the whole experiment

Experimental Sheep.

Four groups, each of 20 sheep, were randomly selected from 80 merino wethers which had been purchased from the eastern wheatbelt where no previous experience of lupin grazing was likely, and then held on a Dandaragan property from September on a pasture containing some old lupin seed. They ranged in age from 2-tooth to fresh, full mouth. After weighing and marking with numbered ear tags, one group was placed in each of the four paddocks.

Experimental Treatments.

Group 1.—Received a ration of hay for the entire experimental period of 97 days and remained in the same paddock.

Group 2.—Also received a ration of hay for the whole period but after 46 days was moved to the paddock occupied until then by Group 4.

Group 3.—Received no hay during the experiment and remained in the same paddock for the entire period.

Group 4.—Did not receive a ration of hay for the first 46 days of the experiment at which time they were moved to the paddock previously occupied by Group 2 and given a ration of hay for the remaining period.



The experimental paddock of grazed dried lupins

Procedure.

The sheep were weighed fortnightly for the first 46 days and then weekly for the remaining period. Where possible a post mortem was conducted on any sheep dying and liver samples sent to the Animal Health and Nutrition laboratories for confirmation of the disease. At the end of the experiment all surviving sheep were forwarded to Robbs Jetty abattoirs for

slaughter and appraisal. Liver samples from every sheep were examined in the laboratory.

The supplementary ration consisted of oaten hay fed twice weekly at the rate of 1 lb. per head per day. The hay was placed in racks, two to each paddock, away from the water trough.

Results of the Experiment.

The following table shows mortalities in different groups.

Table I
MORTALITIES ACCORDING TO EXPERIMENTAL TREATMENTS

Group	1	2	3	4
No. of deaths	Nil	Nil	8	3
Percentage of deaths	Nil	Nil	40	15

There were no deaths in either of the supplementary fed Groups 1 and 2 and no further deaths in Group 4 after feeding commenced. Where no hay was fed, eight deaths occurred in Group 3 whereas in Group 4 three died in the first 46 day period, when they received no hay.

From the 11 sheep that died during the experiment seven liver samples were forwarded for examination and in all cases severe lupinosis damage was reported.

Weight Losses.

Table II
WEIGHT CHANGES OF EXPERIMENTAL ANIMALS

Group	Initial average weight	Average weight after 46 days	Average weight losses for the 46 day period	Average weight after 97 days	Average weight losses over the 97 day period
1	lb. 103.6	lb. 97.7	lb. 5.9	lb. 92.2	lb. 11.4
2	103.5	101.6	1.9	96.0	7.5
3	103.8	92.6	11.2	78.0	25.8
4	97.31	82.6	14.7	84.2	13.1

All groups lost weight over the 97 day experimental period however, Group 3, which received no hay, lost more than three times as much as the supplementary fed Group 2 and twice as much as the supplementary fed Group 1.

Group 4 lost weight rapidly in the first 46 days when on lupins only and, when given a hay supplement, made small body weight gains in the next 51 days.

Carcase Weights.

Table III
CARCASE WEIGHTS

Group	1	2	3	4
Average Carcase Weight	35.9	37.4	25.3	29.4

On examination after slaughter at Robb's Jetty, the sheep from the two supplementary fed Groups 1 and 2 had much higher carcase weights and carcase gradings than either the Group 3 (no supplementary feeding) or Group 4 (which received hay for only the second half of the experiment.)



Representative carcasses from each of the groups in the experiment. The two on the left had hay supplements for the whole period, the third carcase did not have any hay and the fourth carcase had hay only for the second half of the experimental period

Carcase Gradings.

Table IV
GRADING OF CARCASES

Number of carcasses in each grading				
Group	1	2	3	4
Grade—				
White	10	10		3
Boner	10	10	8	11
Sausage			4	3

While the carcase weights of Group 4 were not much higher than Group 3 they received better carcase gradings.

Liver Symptoms.

Liver samples from every sheep slaughtered at Robbs Jetty were examined in the laboratory. All livers showed severe damage resulting from lupinosis. Those of Group 3 were the most affected, followed by Group 4. Group 1 and 2 were the least affected. The intensity of liver damage was correlated to weight loss and with the carcase gradings.

Cost of Hay Supplement.

It is important to note that the cost of the hay for the whole experimental period at 8s. 1d. per head, was obviously economically sound as the price difference between the supplemented and unsupplemented groups of the sheep was 18s. 8d. per head. The gross returns showed even greater differences at £62 5s. 5d. and £26 3s. 6d. respectively as this takes into account losses due to deaths. Labour costs of feeding are not taken into account.

The prices obtained at Robb's Jetty when the sheep were sold for slaughter, were equivalent to prices ruling at the metropolitan markets at the time.

Discussion.

The most important result of the experiment was the striking confirmation obtained for the hypothesis that the incidence of lupinosis could be reduced by means of supplementary feeding. All deaths in the experimental sheep occurred in groups receiving no supplementary feeding.

For the first 46 days of the experiment, before any of the sheep had been changed from one paddock to another, two of the sheep in Group 4 died of lupinosis. A third sheep died three days after moving and obviously was so badly affected with the disease that there was no chance of recovery.

At the change over period, when Groups 3 and 4 had fed solely on lupin roughage during the previous 46 days, the average live weight of these groups did not differ significantly, but both were significantly lower than Groups 1 and 2. However, at the end of the experimental period when Group 4 had received a supplementary ration of hay for 51 days, the average live weight of that group was significantly higher than Group 3 and similar to Groups

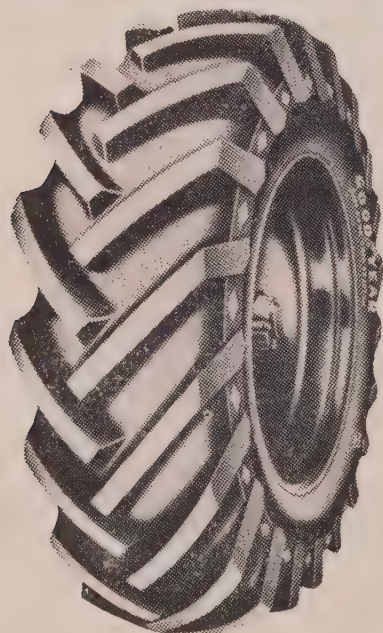
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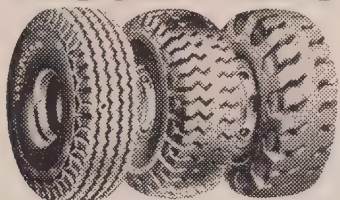
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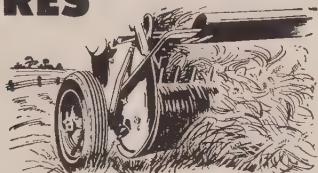
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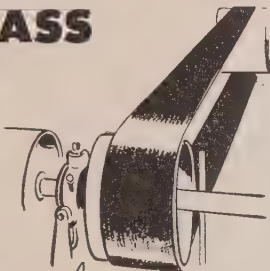
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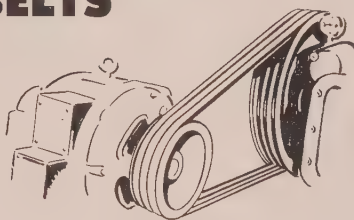
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1 and 2 (see Table II). After the remaining sheep of Group 4 were shifted and fed a ration in the paddock where Group 2 had been grazing, deaths ceased and weight losses stopped.

The sheep Group 2 which had received a hay ration were moved into the paddock where lupinosis mortality had already occurred and the hay ration continued. None of these sheep died and the weight losses were not significantly different to Group 1 which also received hay throughout the experiment.

The purpose of interchanging Groups 2 and 4 after 46 days was to confirm that the absence of deaths from lupinosis in Group 2 was not specific to the paddock but was in fact due to the feeding of the hay supplement. As no deaths occurred in Group 2 before or after they were shifted and the hay supplement continued, it is reasonable to assume that the deaths in Group 4 were due to a lack of supplement and not to some differences between the two paddocks.

There are, however, two very obvious facts—firstly, the sheep receiving the oat ration for the whole period did not gain in weight as would be expected and secondly, that all sheep suffered some liver damage and that the degree of this damage was correlated with loss of live weight.

These differences in weight losses and deaths between the various groups suggest that oat hay has a protective action; that there is some dietetic factor involved; or, that the sheep did not eat enough of the lupin roughage to cause the rapid loss in condition and death.

The supplementary fed groups did not have as severe liver damage as either the unsupplemented group or the group receiving hay for the last 51 days of the trial only.

Mention should be made that the hay was fed twice weekly and the sheep were often without hay for 2 to 3 days as the whole ration was eaten by the second day.

It may be that sheep need a continuous diet of hay to eat with the lupins, or that the hay ration of 1 lb. per head per day may not have been enough to supply the protective action or dietetic factor involved to overcome the effect of the disease.

Experimental work is in progress at the Animal Health and Nutrition Laboratories under the direction of Dr. M. R. Gardiner,

to determine the specific cause of the disease; also field trials will be continued on Messrs. K. and V. Williams property, over the 1960/61 summer, to study the effect of different grazing and sheep husbandry practices.



A lupinosis affected sheep from the non-supplemented group

RECOMMENDATIONS

The experiment has demonstrated the importance of a supplementary ration in controlling the more severe manifestations of lupinosis. It should be possible in practice to provide this supplement by alterations in grazing management thus avoiding the necessity for hand feeding. Deferred grazing in early winter will allow grasses to establish in a lupin stand, or, a high stocking rate early in the season will reduce the lupin density. The sowing of cereals in a lupin stand or in an adjacent area, allowing access, will provide a continuous ration of other roughage.

Recovery of slightly affected sheep can be brought about by moving them off lupins or chaining and burning the lupins to remove the parts of the plant causing the disease. (Neil et al (2).)

Affected sheep should not be moved onto green pastures as photosensitisation is likely to occur, delaying the recovery.

SUMMARY

- (1) The feeding of a supplementary ration of oaten hay to sheep grazing in a lupin stand prevented any deaths in a 97 day experimental period.
- (2) Feeding hay prevented any further losses in a group which had suffered three deaths in a 46 day period when it received no hay supplement.
- (3) The control group receiving no hay suffered eight deaths (40 per cent.) in the 97 day period.
- (4) Live weight losses were reduced by over 60 per cent. by feeding a hay supplement and in a group affected by lupinosis the feeding of hay prevented further weight losses.
- (5) Carcase weights and carcase gradings of the supplemented groups were much superior to the non-supplemented groups.
- (6) The non fed groups had the greatest liver damage from lupinosis.

- (7) Some of the aspects of grazing management likely to control the disease have been discussed.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Messrs. K and V. Williams for their valuable advice and assistance in conducting this trial which called for a considerable amount of management and attention to detail.

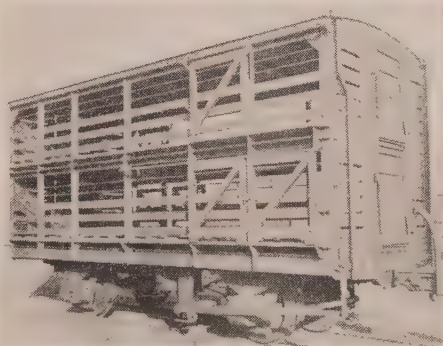
Grateful acknowledgment is made to Mr. W. J. Toms for the assistance rendered by him in the designing of the trial and to Dr. M. R. Gardiner, Chief Veterinary Pathologist, at the Animal Health and Nutrition Laboratories for the detailed examination of the livers.

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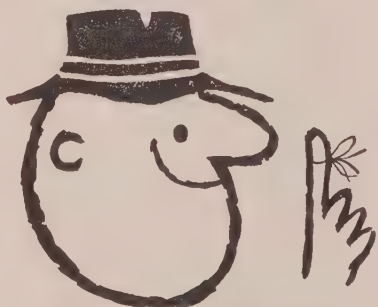
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TREE LUCERNE

A Fodder Crop with a Future

By L. C. SNOOK, D.Sc., Animal Nutrition Officer

IN December, 1952, an article was published in this Journal drawing attention to the potential value of white flowered tree lucerne (*Cytisus prolifer*) as a source of nutritious green fodder during the dry summer months. Figures were quoted to show that heavy yields could be obtained year after year with very little effort, and no outlay other than for fertiliser. The advantages to be gained from the cultivation of this tree were made very apparent and many farmers set out to grow the shrub.

It must be admitted, however, that worthwhile success has been achieved on only a limited number of properties. Fortunately, these successes have been outstanding and indicate that further consideration of the shrub is justified. It is proposed therefore, to again outline the merits of tree lucerne and then discuss the various factors which have discouraged widespread cultivation.

WHERE DOES IT GROW?

Tree lucerne originated in the Mediterranean region and was brought to Australia as an ornamental shrub. It grows on a wide variety of soils under an extensive range of climatic conditions. Vigorous shrubs can be seen throughout Southern Australia and as far north as New England in N.S.W. and Northampton in Western Australia. Self-grown thickets are common on vacant land throughout the south-west of this State. The soils supporting these



Fig. 2.—Nedlands, June 1956. This photograph shows regrowth on test trees which had been cut in March

thickets range from deep sand on the coast to lateritic gravel in the Darling Ranges. Tree lucerne will not persist on heavy soils which become water logged over the winter months. This appears to be the only soil type which must be avoided.

WHAT IS ITS FEED VALUE?

Tree lucerne is fully equal in food value to ordinary lucerne or to best quality young mixed pasture. Analytical details are given in Table I. In most of the samples the small stems were included, as well as leaves, so as to represent the material which would be eaten. The lush young re-growth obtained after grazing or cutting is particularly nutritious. In general practice the shrubs are kept in reserve until the late summer. The foliage can then supply protein, phosphorus and vitamins at present lacking in the diets of many animals on dry mature herbage.



Fig. 1.—Nabawa, September 1955. Trees planted by H. B. Fawcett in August 1954, on open sandplain. These trees now meet overhead and are grazed by sheep as high as can be reached

Table 1
TREE LUCERNE
COMPOSITION OF FOLIAGE AND SMALL STEMS
(All figures as a percentage of the dry matter)

Origin of Sample	Date Sampled	Crude Protein	Crude Fibre	Crude Fat	Carbo-hydrate	Total Ash	Calcium as Ca	Phosphorus as P
Merredin	17/12/48	18	14	4	58	6	1.12	0.17
Avondale	20/5/50	20	19	4	52	5	0.83	0.12
Gabbalong	8/10/58	18	30	2	45	5	0.48	0.18
Mayanup	14/7/54	25	22	4	44	5	0.57	0.19
Nedlands A.H.N. Lab.	24/9/54	23	25	4	38	10	1.62	0.20
Nedlands, A.H.N. Lab.	10/8/57	19	32	4	41	4	0.56	0.22
South Perth—Young growth 18 in. long	25/5/50	25	27	4	39	6	0.62	0.32
For Comparison—Best quality young mixed pasture		25	21	3	40	11	0.9	0.35
Cereal hay of average quality		7	28	2	56	7	0.1	0.17
F.A.Q. Wheat Grain		10	2	2	84	2	0.04	0.24



Fig. 3.—Pingelly, February 1960. Regrowth on trees which had been severely grazed by sheep (B. Clifton)

PALATABILITY

Farmers hold two contrasting opinions concerning the palatability of tree lucerne. Some say stock will not eat the shrub at all, while others claim that it is difficult to preserve the shrubs from severe overgrazing. Under different circumstances, both statements can be correct. When ample alternative green feed is available stock generally leave tree lucerne unmolested. This explains why many farmers in the lower south-west state that the shrub is of no value as a fodder. Sheep, cattle and poultry all have to acquire a taste for the foliage but there need be no fear that it will not be eaten when alternative feed is in short supply. In actual fact, the preference of animals for alternative feed is a distinct advantage, as during the winter months the farmer

can utilise the ground feed in paddocks containing tree lucerne. These trees often provide welcome shelter until the pasture becomes less abundant or less attractive. The grazing animals will then commence to eat increasing quantities of the tree lucerne. Animals accustomed to grazing on it will eat stems as thick as a pencil so that shrubs used for intermittent grazing can be eaten back to a compact base very quickly.

There is no need to leave planted paddocks unstocked so that weeds and grasses run riot, to eventually become a fire hazard. The winter grazing and shelter provided by fields containing tree lucerne is one of the most important assets to be obtained from this form of husbandry.

OVERGRAZING

Many farmers consider that the plant is too vulnerable to overgrazing to be considered as a source of greenfeed in the paddock. Towards the end of a long dry summer it is to be expected that the shrub will become particularly attractive. Cattle will break down quite large trees to obtain the foliage from high limbs, and sheep will strip the bark from the main trunk. With correct management however, the trees can be grazed without any risk of damage. All palatable forage crops need protection from stock and in the section on "Utilisation" special attention is given to ways and means of harvesting this one with minimum trouble. It should also be remembered that overgrazing is a problem

mainly where many animals have access to only a few trees. Where large areas are planted controlled grazing becomes a relatively simple matter.



Fig. 4.—Nedlands, April 1956. Foliage within reach grazed by sheep. Most of bark was eaten in May

YIELDS PER ACRE

If tree lucerne is to be grown extensively it must give assured yields comparable to other crops which can be grown. At the Animal Health Laboratories at Nedlands careful measurements were made over a period of years of the amount of edible dry matter which could be obtained from trees growing on deep coastal sand. These trees did not receive any supplementary water but were given regular dressings of superphosphate plus essential trace elements. The information obtained there indicates that well-grown trees planted every ten feet in the rows will yield about 60 lb. of edible dry matter per annum. If the rows are 22 feet apart about 200 trees will be required per acre. On this basis a field planted to tree lucerne could be expected to return 5 tons of nutritious dry matter per acre each year for many years. This dry matter is available in the form of green feed whenever the farmer should require it, the green feed being well balanced in all the essentials required by grazing animals.

In addition, the area will grow the usual cover of winter annuals, or crops can be planted between the rows. This ground feed can be particularly valuable. An area planted with tree lucerne can be depended upon to supply heavy yields of nutritious feed for use in winter and in summer.

ESTABLISHING TREE LUCERNE

Most farmers concede that tree lucerne is of considerable potential value but consider that the difficulties and costs associated with establishing large areas are too great to merit consideration. Fortunately, some practical farmers have shown that these difficulties are more apparent than real. Simple effective methods have been evolved to suit specific conditions. At this stage it is appropriate to emphasise that we are dealing with a crop which is expected to give high yields for many years. To establish such a crop careful planning and a considerable outlay in labour and fertiliser is justified. Even so, the cost is trivial. Mr. Basil Clifton of West Pingelly has been particularly successful at establishing and utilising it. Last autumn, with the methods he has evolved it took two men four days to prepare the land and seed, and plant 24 acres. At £3 per man daily, this works out at £1 per acre. Obviously, if a farmer decides that tree lucerne is worth trying, labour costs will be no deterrent.

STARTING WITH SEED

Tree lucerne seed can be purchased at 5s. per ounce. An ounce contains over 1,000 seeds, so theoretically this should suffice for several acres. These seeds are "hard" and may not germinate if planted without treatment. In tests carried out at this laboratory treatment with boiling water has proved most effective. A saucepan of water is brought to the boil and the seed is dropped into the water as the container is lifted off the stove. By the



Fig. 5.—Pingelly, February 1960. Tree lucerne in an erosion gully

(B. Clifton)

time the water has cooled the seeds should have swollen to double the original size. These seeds should be collected in a strainer, mixed with the general *Medicago* culture as recommended for ordinary lucerne, and planted as soon as possible. Where only a small number of seeds have to be treated, these can be "nicked" with a pair of scissors or a razor blade, so that the hard seed coat is broken and water can enter and cause swelling.

Treated seed can be planted by hand in the permanent rows without a great deal of effort, particularly where the line can be ploughed, alternatively, the treated seed can be mixed with compost and dribbled along the line from the back of a vehicle. A farmer at Gabbin obtained an excellent stand by mixing treated seed with boiled wheat and sowing this through one run of a combine. The seeds seem to germinate readily if sown with organic matter or animal manure. Apparently the heating which takes place cracks the seed coats. Excellent germinations have been obtained where untreated seeds have been mixed with animal manure to that a portion containing several seeds can be dumped with a spade every ten feet along the line. The possibility is being explored of preparing mixtures of dung and fertiliser which can be made into cubes or pellets each containing one or two seeds.



Fig. 6.—Nedlands, April 1953. Ewes and lambs eating tree lucerne foliage

These pellets could be planted with minimum bother. Tree lucerne could be grown with considerable advantage in the good soil which is often found on rocky outcrops. The machines which were used for

dropping rabbit baits in furrows could be adapted for use in such country. Obviously, the farmer who really wants to do the job properly, will soon find an effective way to plant seed at a low cost.

SEEDLINGS

Farmers may prefer to plant individual seeds in tins or discarded cardboard drinking cups. The planting can be done in February or March so that robust seedlings are available for planting soon after the opening winter rains. Such plants get away to a good start and in the drier areas could be sufficiently well established to survive the first summer without watering. The seedlings quickly develop a long tap root which is easily damaged in transplanting. For this reason it is best to plant the seeds in the permanent position or in containers which reduce interference with the roots.

Post-hole augers are very useful for preparing land for seedlings. Mr. Fawcett at Nabawa obtained a most successful stand on hungry sand plain country by digging an auger hole, placing a little fowl manure and fertiliser at the bottom, covering this with six inches of soil and then planting a seedling in a tin with the bottom removed.

Successes have been achieved by transplanting the seedlings which grow naturally around old trees, particularly after a fire. This transplanting must be done speedily and with care, otherwise serious wastage is inevitable.

If seedlings are obtained from the metropolitan area care should be taken to avoid introducing pests on the roots. This danger is a real one and there is little doubt that many of the failures have been due to introduced infections. Mealy bug, for example, will soon kill seedlings which have suffered stress during transplanting. The use of clean seed eliminates this danger where tree lucerne is to be established in new areas.

UTILISATION

Tree lucerne will prove of greatest benefit where stock can be used to harvest the foliage. It has been shown experimentally and in practice that the trees respond very well to intermittent cutting or grazing. In trials carried out at the A.H.N.

Laboratory at Nedlands the young plants were cut back in the first year to encourage branch formation at ground level. Cuttings were continued at intervals over a period of years so that the stump became a mass of short, thick branches with the protective effect of a porcupine. After each harvest this stump was virtually defoliated but regrowth was rapid. This regrowth of long, soft shoots constituted a heavy mass of highly nutritious foliage. It was argued that, with intermittent cutting or grazing, the high yields obtained in these test rows could be duplicated under field conditions.

Mr. Basil Clifton, of West Pingelly, has demonstrated that areas planted with tree lucerne give a high return when grazed intermittently. The planted areas are used mainly as a course of feed in the late summer and early autumn, but it is estimated that the established stands carry the equivalent of **10 sheep per acre per annum**. Mr. Clifton has used cattle as well as sheep as grazing animals. The cattle ate back the trees very severely but the recovery was remarkably good. It is essential, of course, to give the trees complete rest during the recovery period.

Where the object is to obtain shrubs for grazing, it is important to avoid trees with one or two main stems. Fortunately, the shrubs have a natural tendency to grow with a number of branches at or near ground level. If a newly planted area appears to be growing into "trees," topping should be carried out. Just how to do this will depend on circumstances. Maybe a mower can be used, or the area grazed quickly with a lot of stock. Cutting by hand may not be out of the question. In a stand planted at the C.S.I.R.O. Research Station at "Glen Lossie" the trees were left to develop for two years by which time they were quite massive. In March, 1960, the branches were cut back to the stumps. The foliage obtained from one acre sufficed to maintain 50 sheep for 14 days. The stumps recovered well from this cutting and the bushy shrubs are now ideal for grazing.

For grazing purposes it seems that the shrubs should be spaced close together in the rows, approximately 6 ft. apart in heavy rainfall areas and 10-12 feet apart where moisture is likely to limit growth. On arable land the rows can be spaced some distance apart so that cereal crops

can be grown. Alternatively, the intervening areas can be sown to perennial grasses to provide "balance" to the leguminous foliage.

Most farmers dislike the idea of harvesting the regrowth from tree lucerne and carting this to stock. It should be remembered, however, that this cutting for direct feeding would not involve anywhere near as much labour or machinery as does the growing, harvesting, and storage of cereal crops. As a matter of fact, the cutting of regrowth from orderly plantings of tree lucerne can be made a simple mechanical job if the modern hedge-clipping equipment commonly used in Britain is employed. The use of animals for grazing has many advantages but mechanical harvesting should not be dismissed without further thought.



Fig. 7.—Kojonup 1960. Tree lucerne planted at "Glen Lossie" Research Station. These trees responded well when cut back severely

USE ON POULTRY FARMS

It is surprising that the plant is not used to a much greater extent on poultry farms. Poultry thrive when the foliage forms an appreciable portion of the diet and the green leaves eliminate any need for supplements of Vitamin A or yolk-colouring concentrates. If trees are planted close to external netting fences poultry will eat all the leaves which grow within reach. These leaves can be rich in protein, Vitamin A and the carotenoids which give rich colour to egg yolk. A sample of leaves collected in November, 1960, and kiln dried yielded a product containing 30 per cent. crude protein, 315 units of B-carotene and 727 units of total carotenoids. This is distinctly superior to the best lucerne meal

obtainable. Large trees shed a lot of seed from Christmas onwards. These seeds are rich in crude protein (25 per cent.) and fats (12 per cent.) and are relished by birds.

FERTILISER

Superphosphate is the main nutrient required and should be applied at the rate of a bag (180 lb.) per acre. Where elements such as copper or zinc are required, these must be applied as for any any other crop. High yields of fodder cannot be expected if fertiliser is lacking.

LONGEVITY

Tree lucerne can thrive for 20 years or more. The erroneous impression that the shrub has a short life is due to the fact that the trees will grow for a while on very poor soil but when the meagre supply of nutrients is depleted it is not surprising that "die-back" and death soon occurs. White ants do not attack healthy trees but invade the dead wood in sickly trees.

DISEASES AND PESTS

Tree lucerne is remarkably free from attack by pests or disease. Failure to thrive is invariably an indication of nutritional deficiencies in the soil. Occasionally, plagues of caterpillars appear; these defoliate the trees and then disappear as suddenly as they came. The test trees at Nedlands suffered one such attack in ten years. It appears that tree lucerne, when correctly fertilised is a particularly "safe" crop.

BENEFIT TO BEE KEEPERS

Tree lucerne flowers profusely during July, August and September. These flowers are an excellent source of pollen and nectar at a period when other flowers are scarce. Apiculturalists will benefit if extensive plantings of tree lucerne are made.

ARE THERE BETTER SHRUBS?

Experience indicates that the ordinary white-flowered tree lucerne or Tagasaste (*Cytisus prolifer*) is the best shrub to cultivate for stock feed. Periodically claims are made that other shrubs would be more worthy of attention. In particular, it has



Fig. 8.—W. Pingelly, February 1957. Sheep grazing tree lucerne planted by Mr. B. Clifton

been said that the yellow-flowered tree lucerne (*Medicago arborea*) will give better results. Repeated attempts have been made by a number of enthusiasts to propagate this yellow-flowered shrub but so far it has failed in the field. For the present, attention should be concentrated on the white-flowered variety which has proved so suited to our conditions. If plant breeders become interested, it is probable that better strains can be isolated and "fixed". Wherever tree lucerne is grown some bushes appear to be outstanding. Seed from such trees may give plantations with higher yields of foliage, quicker recovery from grazing, or greater drought resistance. By using growth hormones it may be possible to use cuttings from selected trees to establish new plantations. It seems that here we have a field for interesting and rewarding research.

REASONS FOR FAILURE

Attempts to grow tree lucerne have failed for many reasons. No doubt the comments already made will have supplied an explanation for some of these failures. Lack of adequate preparation is the most common fault. There is no short-cut to success, and careful planning is essential. Practical farmers have already shown that if attention is given to the fruits of experience, there is every reason to anticipate success. The most serious errors are:—

Planting seed without treatment to ensure germination.

Planting seed or seedlings too late in the winter.

Planting on heavy, water-logged soils.

Subjecting the young plants to severe competition from weeds or established pasture.

Failing to use adequate fertiliser, particularly where trace elements are required.

Over grazing or continuous grazing.

Severe cutting or grazing in mid-summer.

SUMMARY

Attention is drawn to the value of white-flowered tree lucerne as a source of palatable, nutritious greenstuff for grazing animals.

Measurements of yields over a period of years indicate that tree lucerne is a highly productive crop which can be grown over extensive areas in Western Australia.

Practical farmers have shown that large areas can be planted quickly and effectively.

It is anticipated that the widespread cultivation of this plant will remove many of the hazards from livestock production in a Mediterranean climate.

ACKNOWLEDGMENT

The analytical data presented in Table I were provided by the Government Chemical Laboratories.



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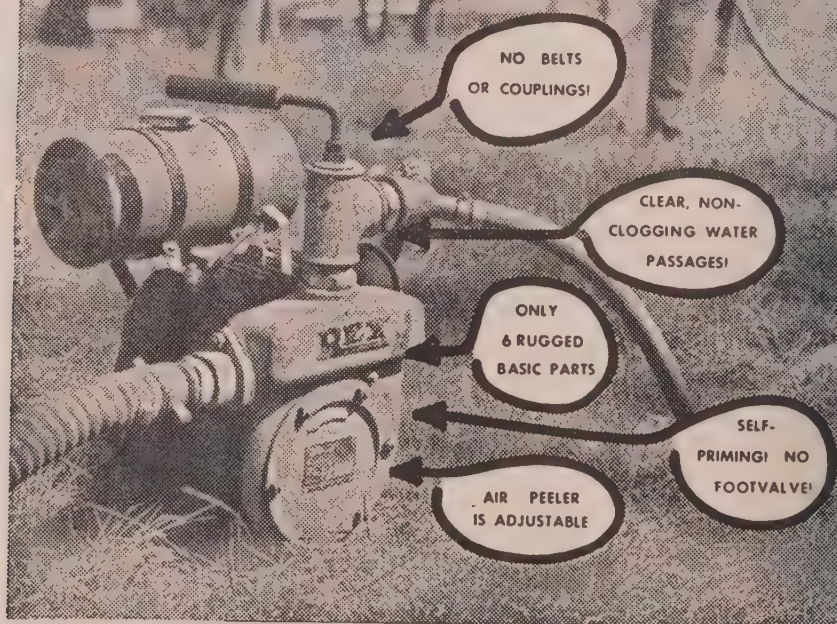
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BACONER CARCASE COMPETITIONS

By H. G. ELLIOTT, Dip. Agric., Assistant Superintendent of Dairying and
S. R. DUNSTAN, M.D.A., Technician

TO further the implementation of its policy to foster the production of high quality bacon, the Australian Meat Board in 1960 again conducted for pig growers in Western Australia, its annual Baconer Carcase Competition.

In previous years, the competition was judged on a basis of 6 zones but for the Competition in 1960, for the first time it was judged on a State wide basis.

The response from pig raisers in submitting entries in 1960 was very good as

there were 102 entries judged; this constituted a record. The previous record number of entries was in 1958 when 86 carcasses were judged.

Judging, was carried out, as in previous years, under the Smithfield System of



Fig. 1—Judging by eye appraisal. Standards for award or marks

Carcase Appraisal at Watsons Food Pty. Ltd., Spearwood.

To qualify for entry, the pig had to be sired by a pure-bred boar (sows could be cross-bred) with a dressed carcass weight between 120 lb. and 160 lb. The treatment of the entries was carried out at the works of Watsons Food Pty. Ltd., Spearwood, and Thomas Borthwicks & Sons (Australasia) Ltd., Albany, between 1st June and 2nd September. Each competitor was allowed to make two entries—one carcass in each entry. A total of £150 in prize money was provided by the Australian Meat Board and Certificates of Merit were awarded to entries scoring 60 points and over.

(b) By Measurement—

"Eye muscle" of Loin—thick	28
Back fat thickness—correct proportion	20
Body length—in proportion to weight	20
Leg Length—short	5
Total	100

(a) *By Inspection:* For these photographic scales are used.

Hams (8 marks)—The bone should be fine and the ham well filled out with lean meat, the space between the legs being U-rather than V-shaped. The hams to be

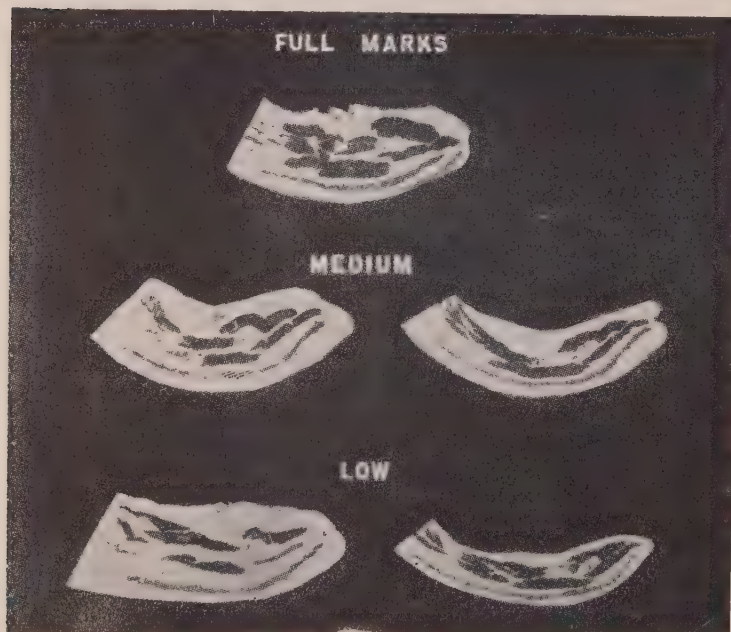


Fig. 2—Standard for award or marks by eye appraisal. Streak (Baconer)

THE SCALE OF POINTS

Judging of the Competition was carried out under a modification of the Smithfield System (breeders points only) as devised by Messrs. H. R. Davidson, John Hammond, Jos B. Swain and Nevil L. Wright.

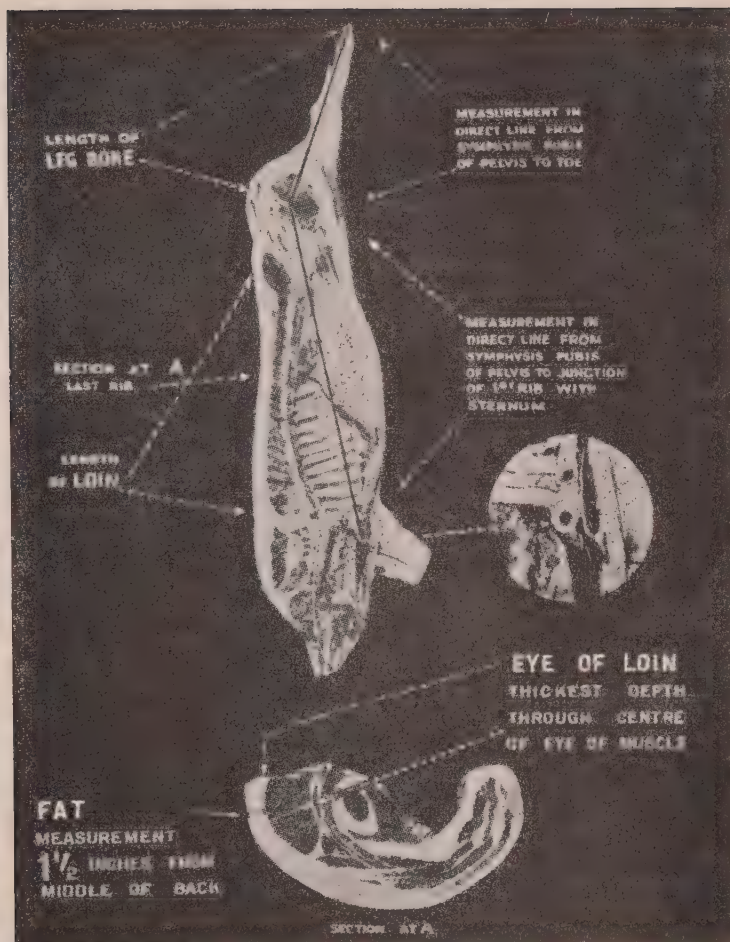
The points for the Competition were as follows:—

(a) By Inspection—	Marks.
Hams—well filled and fine boned	8
Shoulders—light	7
Streak—thick, full of lean meat	12

judged are compared with the photographic scale of hams (Fig. No. 1) which shows the shape for maximum (8), minimum (1) and intermediate (4) marks, to be awarded.

Shoulders (7 marks)—These should be light in proportion to the rest of the carcass for it is a low-priced part. (In judging the shoulders are matched against a photographic scale of the shoulders (Fig. No. 2) which shows the shape for maximum (7), minimum (1) and intermediate (4) marks, to be awarded.)

Fig. 3—Judging by award or marks from measurement



Streak (12 marks)—Not only should the belly be thick, but it should contain a high proportion of lean meat. Comparison with the photographic scale (Fig. 3) is made. The maximum marks (12) are given for a streak which is both thick and full of lean meat. The minimum marks (1) are given either for one which is thin, or for one which is thick but which contains a high proportion of fat. Illustrations of intermediate marks (6) in each case are also shown.

(b) *By Measurement*: Measurement in millimeters rather than in inches has been adopted for the sake of greater accuracy and the avoidance of fractions. From tables the marks corresponding to any

particular measurement can be read off. In the case of thickness of eye muscle and length of body, the highest marks are given for the maximum measurement, and in the case of the length of leg for the minimum measurement. For thickness of fat, on the other hand, as for suitability of carcass weight, the highest marks are awarded for an optimum measurement.

"Eye Muscle" of Loin (28 marks)—The thickness is measured half way along its width. This gives the best measure of the thickness of lean meat throughout the carcass. Different carcasses vary much more in the thickness than in the width of the muscle, so the thickness has been selected as the index of meat.

Back Fat Thickness (20 marks)—This is measured one and a half inches for baconers from the middle line, with one point of the callipers at the edge of the "eye muscle" and the other just on the inner layer of the skin. This gives a better measure of the amount of fat in the carcass than does the measurement of the fat at the shoulder, for it is the last part of the back fat to develop. Fat differs from all other points for marking, inasmuch as for each weight group of carcass

there is an optimum requirement of back fat; there can be too little as well as too much. Consequently the scale for converting measurements to marks unlike the others, is extended on both sides of the optimum.

The list of prize winners of the 1960 Competition is as follows :—

Place	Points	Entrants	Breed
1st	92	A. K. Stirling & Co., Kendenup	Berkshire
2nd	86	R. L. Poad, Dardanup	Berkshire x Large White
3rd	83	Mrs. E. M. Monk, Pingelly	Black
4th	82	J. Thompson, Jr., Bramley	Berkshire x Large White
5th	81	W. G. Burgess, Burgess Siding	Berkshire x Large White
6th	80	J. Littlefair, Eastbrook	Berkshire
6th	80	R. & D. Bashford, Northcliffe	Berkshire x Large White
8th	79	Earl Bros., Cowaramup	Tamworth x Berkshire
9th	78	Mrs. V. J. Clews, Cowaramup	Berkshire x Large White
9th	78	A. F. Paterson, Ambergate	Berkshire x Large White
9th	78	R. L. Poad, Dardanup	Landrace x Large White
9th	78	Mrs. E. M. Monk, Pingelly	Berkshire x Large White
9th	78	L. J. Newing, Tambellup	Tamworth x Berkshire
9th	78	L. & D. Eastford, Northcliffe	Large White x Berkshire
9th	78	C. L. Pailthorpe, Pinjarra	Large White

Chart No. 1
W.A. BACONER CARCASS COMPETITION, 1960—
AVERAGE SCORE ACCORDING TO BREEDS

Breed	No. of Entries	Highest Score	Lowest Score	Av. Score
Berkshire x Large Black x Berkshire	3	86	69	77.66
Berkshire x Large White	8	83	70	76.25
Berkshire x Berkshire x Large White	2	75	68	71.50
Berkshire x Tamworth x Berkshire	2	76	63	69.50
Berkshire x Large White x Berkshire	5	77	60	66.80
Berkshire	22	92	52	66.31
Average Berkshire Sire	42	92	52	71.33
Large White x Berkshire x Large White	7	82	60	71.29
Large White x Berkshire	15	78	62	71.20
Large White x Large White x Berkshires	9	76	61	69.66
Large White	20	79	45	67.90
Average Large White Sire	51	82	45	69.64
Landrace x Large White	3	78	62	73.66
Landrace x Berkshire	5	70	42	62.80
Average Landrace Sire	8	78	42	66.87
Tamworth x Berkshire	2	80	78	79.00
Average Tamworth Sire	2	80	78	79.00
TOTAL	102	92	42	70.96

Chart No. 2
W.A. BACONER CARCASS COMPETITION, 1960—PERFORMANCE OF BREEDS AND CROSS BREEDS

Breed	Inspection					Measurement					Total
Maximum Points	Nos. of Entries	Chilled wt.	Ham 8	Shoulders 7	Streak 12	Eye Muscle 23	Back Fat 20	Body Length 20	Leg Length 5		
Pure Berkshires	22	136.7	67.5	56.5	74.2	56.3	78.8	72.8	70.9		66.31
Berkshires x Large White	8	141.5	82.8	77.1	82.3	72.8	85.0	71.25	55.0		76.25
Berkshires x Large White x Berkshire	5	141.4	75.0	48.5	73.3	62.9	70.0	64.00	84.0		66.80
Berkshire x Berkshire x Large White	3	125.33	72.5	42.8	83.3	86.5	71.6	83.00	46.6		77.66
Berkshire x Tamworth x Berkshire	2	155.0	75.0	42.8	83.3	94.6	65.0	60.0	25.0		71.50
Berkshire	2	141.5	87.5	64.3	58.3	67.8	72.5	72.5	60.0		69.50
Average Berkshire Sire	42	138.4	72.9	57.9	76.0	64.8	77.5	72.6	64.9		71.33
Large White	20	138.4	78.75	80.0	80.9	49.6	77.5	81.0	30.0		67.90
Large White x Berkshire x Large White	7	142.7	73.2	49.0	84.5	72.9	75.7	67.1	54.1		71.29
Large White x Berkshire	15	142.5	72.5	73.3	73.9	58.3	89.3	71.3	58.6		71.20
Large White x Large White x Berkshire	9	141.1	76.4	76.2	74.1	50.8	84.4	82.2	35.5		69.66
Average large White Sire	51	140.7	75.7	73.1	78.1	55.6	82.0	76.5	43.1		69.64
Landrace x Large White	3	140.66	79.2	76.2	77.5	63.1	93.3	71.6	33.3		73.66
Landrace x Berkshire	5	144.0	77.5	62.85	68.3	62.1	74.0	46.0	52.0		62.8
Average Landrace Sire	8	142.75	78.1	67.8	73.0	62.5	81.2	55.6	45.0		66.87
Tamworth x Berkshire	2	134.00	68.75	71.4	100.0	80.3	90.0	70.0	40.0		79.00
Average Tamworth Sire	2	134.0	68.75	71.4	100.0	80.3	90.0	70.0	40.0		79.00

Body Length (20 marks)—This is measured with a tape measure from the edge of the symphysis pubis bone to the junction of the sternum with the first rib. It gives a measure of the length of the valuable loin joint which can be cut off the carcass. A high proportion of this to the weight of the carcass as a whole increases the value of the carcass for cutting purposes.

Leg Length (5 marks)—This is measured with a tape measure in a straight line from the edge of the symphysis pubis bone to the tip of the toes. When taken in relation to the weight of the carcass it gives a measure of the amount of bone in the carcass.

The judging this year was carried out by Mr. H. Watson of Watsons Foods Pty. Ltd., Mr. R. Anderson, Veterinary Surgeon, Department of Commerce, H. G. Elliott, Dairy Division, Department of Agriculture. Their comments were as follows:—



Fig. 4—Displaying the State Champion carcass



Fig. 5—The Reserve Champion carcass

- (1) That the general quality of the carcasses was good but they were unanimous that they did not come up to the standard of the entries submitted by competitors last year.
- (2) That it was very pleasing to see the almost complete absence of overfat carcasses and that there has been a trend in this direction over the last few years.
- (3) That generally the hams were good, but not up to the standard of the previous year.

- (4) That the general appearance and presentation of the carcasses was very good.
- (5) That there was a tendency as has been the case over the last few years for the shoulder to be on the heavier side.
- (6) That the streak in most carcasses was good, but a number of entries were penalised for poor finish, having good lean meat with an insufficient layer of fat.
- (7) That the eye muscle was good but in many cases was associated with a poor streak.
- (8) That the average length of carcasses was a little shorter than in the previous two years but was still very good.

- (9) That the back fat showed a pleasing improvement and gained higher points than any previous year.
- (10) That with regard to leg length, less points were scored than in previous years as the shanks are tending to become longer.

The average age of the pigs entered was 6.1 months with an average dressed weight of 139 lb. which represented an average dressed weight gain per month of 22.4 lb.

Over the years since the commencement of the Baconer Carcase Competitions, certain trends have been observed (see Chart No. 2).

COMMENTS ON TRENDS SINCE 1948

1. There has been a pleasing tendency for an increase in body length, consequently there has been a gradual improvement in the overall scores in this section (see Graph No. 1). This tendency for greater body length appears to be a culmination of the policy of many breeders over a number of years.

During the period of the Competition pigs sired by a Large White boar have consistently done well in this section. To date pigs sired by a Landrace boar, only in the Competition for the last 2 years, have not been prominent in this respect, although claims are often made that the Landrace has outstanding body length.

2. The average overall leg length has gradually increased, resulting in a general decline in the average points for this section (see Graph No. 2). As this is an undesirable feature it is suggested that



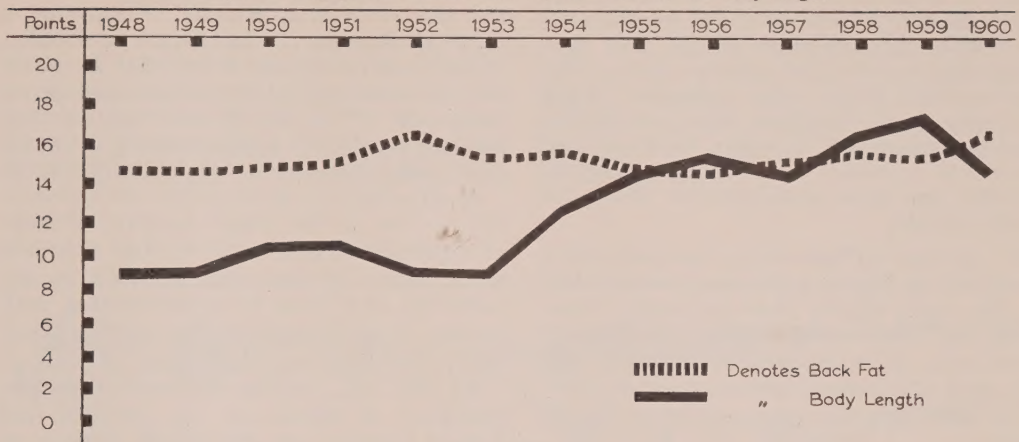
Fig. 6—The best eye muscle in the 1960 competition. The Reserve Champion.

Chart No. 3
BACONER CARCASE COMPETITION

Year	No. of Entries	Average Weight (lb.)	Average Age (Months)	Ham 8	Shoulders 7	Streak 12	Eye Muscle 28	Back Fat 20	Body Length 20	Leg Length 5	Total
1948	74	148.1	NA	6.3	5.5	9.3	16.7	14.6	9.1	3.4	65.1
1949	52	NA	NA	5.4	5.0	7.9	15.2	14.6	9.2	3.1	60.5
1950	57	NA	6.5	5.2	4.7	8.1	20.6	14.7	10.2	3.8	67.3
1951	58	NA	NA	5.4	4.3	7.8	18.8	15.2	10.5	3.5	65.1
1952	52	NA	NA	5.0	4.1	7.9	19.6	16.3	9.2	2.8	64.9
1953	60	NA	NA	5.1	4.3	7.8	19.3	15.6	9.1	3.4	64.6
1954	51	138.0	NA	5.4	4.4	8.5	15.2	15.9	12.8	3.1	65.4
1955	51	142.1	NA	5.8	5.0	7.9	17.2	15.0	14.8	2.7	68.4
1956	65	NA	NA	5.8	4.8	9.3	19.1	14.9	15.4	2.7	72.0
1957	75	140.1	6.4	6.0	4.3	7.6	18.8	15.5	14.6	2.5	71.3
1958	86	139.0	6.3	5.9	5.0	9.5	18.7	15.8	16.5	2.5	73.3
1959	62	141.8	6.1	6.4	5.1	10.3	22.1	15.7	17.7	2.8	80.1
1960	103	139.0	6.1	6.0	4.7	9.2	17.1	16.5	14.8	2.6	70.96

NA—Not Available.

Graph showing points allotted annually for back fat and body length



more attention could be paid to improvements in this regard, by selection of breeding stock with shorter legs. Over the years the pigs sired by a Large White boar have had the longest legs, but since 1955 there has also been a similar deterioration in pigs sired by a Tamworth.

3. The overall score for the eye muscle has varied considerably from year to year, with very little general improvement. The carcasses which had a Berkshire sire have proved to be the most satisfactory in this section.

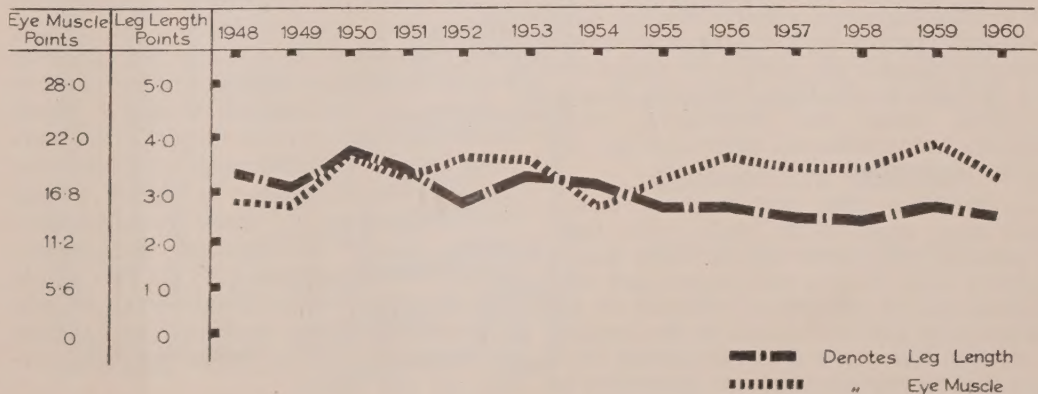
4. The increase in the average marks awarded for back fat are significant (see Graph No. 1), because it indicates that the majority of competitors are conscious of the necessity for an improved standard of feeding. Generally pigs sired by a Large White boar have showed a slightly lesser tendency to overfatness.

It is pleasing that pigs have been forwarded for slaughter in more satisfactory condition than was the case some years ago because it shows a response to a campaign promoted by the Bacon Curers, Stock Firms and the Department of Agriculture.

5. The shoulders of pigs sired by a Berkshire have been consistently heavier than with any other breeds. Fortunately this is already a well known fact amongst the Berkshire breeders many of whom are selecting their breeding stock from animals which are more desirable in this respect.

6. Carcasses sired by either Berkshires or Large Whites have generally had good hams, but since their entry into the Competition in the last 2 years carcasses with Landrace sires have been the most outstanding in this section.

Graph showing points allotted annually for leg length and eye muscle



7. It is apparent from the figures supplied by competitors that the average age at which the desirable weight has been achieved by the baconers is lower. This corresponds with other evidence which indicates better selection, improved feeding and husbandry. It has been observed that crossbred animals have reached maturity quicker and more economically than pure bred animals.

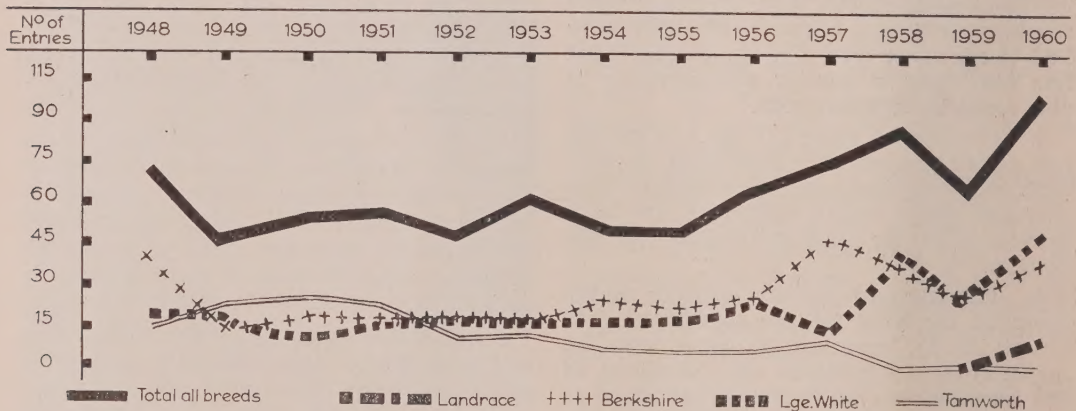
8. **Crossbred Pigs**—Since the commencement of the Baconer Carcase Competitions it has been shown that generally crossbred pigs have scored better than the pure bred ones. It is emphasised however, that the sires of carcasses entered must be purebred, although this need not be so for the dam.

the meat and bone building nutrients in the ration—that is a ration containing a high percentage (18 per cent.) of protein. It has been frequently found that the addition of creepfeed to the piglets diet at an early age (3 weeks or earlier) is most advantageous as a supplement to the sow's milk and results in better weaning piglets.

At all stages it is essential for the protein to be of the right quality. Protein of vegetable origin, such as that obtained from cereal grains and pastures is insufficient and must be supplemented with protein of an animal source, such as skim-milk, meatmeal or whalemeal.

As the pig approaches maturity less emphasis is placed on the skeletal and muscle growth and the protein portion of

Graph showing total number of entries and breeds annually



Results on an average, have shown that the carcasses from a Berkshire sire have been the most satisfactory, and that generally the Berkshire x Large Whites have been amongst the top performances. These findings indicate the wisdom of the Dairying Division of the Department in recommending either the Berkshires, Large Whites, Tamworths or their crosses, for bacon production.

9. **Feeding**—The ideal baconer has a high lean meat-to-fat ratio, with light shoulders, full hams, strong loins and a lengthy body. It is a well known fact that feeding has an important influence on the growth rate and the quality of the carcase.

During the early growing period it is essential to provide adequate quantities of

the diet can be reduced gradually down to 14 per cent. at the baconer stage.

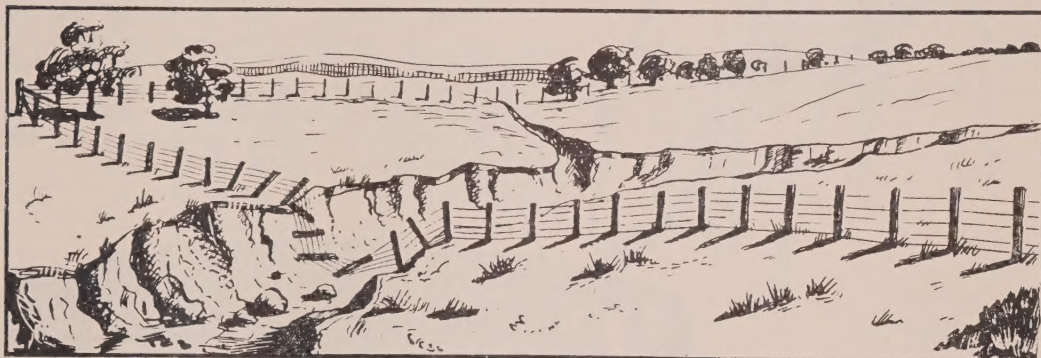
Carcasses from pigs which have been inadequately and incorrectly fed usually score poor points on the appraisal of body length, back fat, shoulders and eye muscle.

There is considerable evidence which shows that the Baconer Carcase Competitions serve a valuable purpose in directing the attention of growers to carcase quality and indicating to their improvements which should be affected. A valuable feature of the competitions are the supply to each competitor of detailed results, and the opportunity of observing the carcasses on display during the day of the presentation of the prizes.

ACKNOWLEDGMENTS

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